THE ENGINEER

A Seven-Day Journal

Non-Ferrous Metals Productivity Report

THE Anglo-American Council on Productivity published on Monday last the report of a productivity team, selected from the wrought non-ferrous metals industry, which visited the U.S.A. last summer. Under the leadership of Mr. W. F. Brazener, managing director of The Mint, Birmingham, Ltd., the team made a study of the methods employed in the U.S.A. in the production of wrought semi-finished non-ferrous products. In its report, the team says that some of the American factories visited were quite small, but their standard of efficiency was much higher than that of the average small factory in this country. The conclusion is drawn, therefore, that what has been made possible in the U.S.A., largely by improvisations without heavy capital expenditure, could be repeated here, the considered opinion of the team being that primary responsibility for increased productivity rests with management. The report goes on to state that productivity in the American industry is definitely higher than it is in this country, but the team's view is that the quality of the American product is certainly no better. It appeared to the members of the team, however, that acceptance of competition, ingenuity, inventiveness and improvisation were universal characteristics throughout the American industry. Linked with them, the report says, is "the national spirit of enterprise and the readiness to take risks." Five sections of the report are devoted to manufacturing technique in the American wrought non-ferrous industry. In some general comments on processes, the team says that there is much in American casting, rolling and tube drawing technique and practice which it would be to the advantage of this country to follow. In wire-drawing there is perhaps very little difference in productive efficiency, whilst about the extrusion process, the team's opinion is that British practice is more efficient in a technological sense than American.

A Water Supply Scheme in Northamptonshire

PROPOSALS for a distribution scheme for the water supply of the Mid-Northamptonshire Water Board's area have recently been completed, and it is intended to start work on a scheme for supplying the northern part of the Board's area as soon as permission is received from the Minister of Local Government and Planning. The proposals for the whole of the Board's area will include the supply of a population estimated at 151,000, including the new town of Corby, the consumption being calculated at 5·8 m.g.d. The northern area, however, is the district requiring earliest improvement, and the works proposed for that area include 53 miles of mains from 3in to 33in in diameter, five service reservoirs and three water towers, the estimated cost being £571,000. Water will be treated and softened at Pitsford and pumped through a 24in main to a service reservoir of 5 m.g. capacity situated alongside the Northampton to Kettering road near the village of Hannington. Two supplies will be taken from it, one northwards towards Kettering, and, at a later stage, another eastwards to Wellingborough, to complete the proposals for the whole area. The northern area supply will be taken from the service reservoir in a 33in main, which will divide at Broughton, one branch supplying Kettering and Corby and the other Rothwell, Desborough and villages on the Board's northern boundary as far as Ashley and Cottingham. The supply of Corby has been carefully considered, and it is proposed that the pressure should be maintained by a series of water towers. The town is at present supplied by three towers, and the contract for a fourth of 100,000 gallons capacity has been let. A fifth tower of 250,000 gallons capacity, situated close to the proposed 2 m.g. service reservoir near the western boundary of Corby new town, is included in the proposals. The new distribution system will supersede a number of small sources of supply in the area and will enable some existing pressure boosting arrangements to be discontinued.

Philips' Sixtieth Anniversary

LAST week, on May 15th, the N. V. Philips Gloeilampenfabrieken, Eindhoven, Holland, celebrated its sixtieth anniversary. The original firm of Philips and Co. was founded on May 15, 1891, by the late Mr. B. F. D. Philips and his son, Dr.-Ir. G. L. F. Philips. After a few years Dr. A. F. Philips, a younger son, joined the company. It is worthy of note that the president and vice-president of the board to-day are Ir. P. F. S. Otten and Ir. F. J. Philips, both members of the family. From small beginnings, with only thirty workmen, the company has grown until it now employs more than 90,000 workmen and staff in its Eindhoven and branch undertakings in Holland and throughout the world. We are glad to record that the Eindhoven factories have made a speedy recovery from their war devastation. The remarkable development of the firm was certainly helped by the wise foresight of the founders, who created in the early days of 1914 a large purely scientific physical laboratory. Ceremonies during the week included the unveiling of a bas relief in the works in memory of the late Dr.-Ir. G. L. F. Philips. The Mayor of Eindhoven also unveiled in the centre of the town a statue of Dr. A. F. Philips. A new demonstration laboratory was inaugurated, while in a new large steel hall a jubilee exhibition of the firm's products was shown. Finally, there were programmes of sports and music and theatrical entertainments in which both employees and townspeople took part.

Old Centralians' Luncheon

THE speaker at the most recent of the Old Centralians' monthly luncheons, which was held on Thursday, May 17th, at Chez Auguste Restaurant, Soho, was Dr. G. M. Lees, the chief geologist of the Anglo-Iranian Oil Company. Dr. Lees spoke of the oil reserves and oil production of the world, and of the importance of the Middle East, his remarks being of particular interest in the light of recent events in Persia. He said that about 60 per cent of the world's oil was produced in the United States; Venezuela and the Middle East (Iran, Iraq, Saudi-Arabia and various sheikdoms, such as Kuwait) each produced about 80 million tons of oil a year, and Russia produced about 35 million tons. There were various other centres of production, such as Roumania where 4 million tons a year were produced and 8 million tons in Indonesia, but none was important on a worldwide scale when compared with those first mentioned. The Middle East was unique on account of the size and yield of the individual wells; the average yield from a single well was about 1000 times that of the average yield from a well in the U.S. The largest oilfield discovered so far was in Kuwait and consisted of a porous sandstone antidine some 60 miles in length. Dr. Lees said that recent developments in the construction of tankers and oil pipe-lines had greatly aided the economic exploitation of the more inaccessible parts of the Middle East oilfields. He thought it very unlikely that any future discoveries of oilfields would radically change the situation, and the Middle East constituted the main oil reserve of the world.

Europe's Coal and Coke Supplies

THE coal sub-committee of the United Nations Economic Commission for Europe has been examining the probable coal and coke situation in the third quarter of this year, in the light of indications about consumption requirements and available supplies. The estimates presented to the committee suggested that next quarter the deficit in European solid fuels would exceed 10,000,000 tons. At its recent meeting, the coal committee reviewed developments connected with its provisional agreement, reached in March, on the distribution of European coal and coke during the current quarter. It was stated that some countries, especially the United Kingdom, had responded favourably to the committee's appeal for additional solid fuel to make up the deficiency on minimum requirements from European sources, a deficiency amounting roughly to 300,000 tons. According to the committee's statement, 230,000 tons of that amount was made available by the United Kingdom, and the committee was able to help to meet the fuel needs of those European countries which were in the most serious difficulty. Some problems concerning fuel supplies in the current quarter remain to be solved, the committee's statement adds, but it is hoped that positive results will be achieved in the very near future.

Fleet Scientific Officer

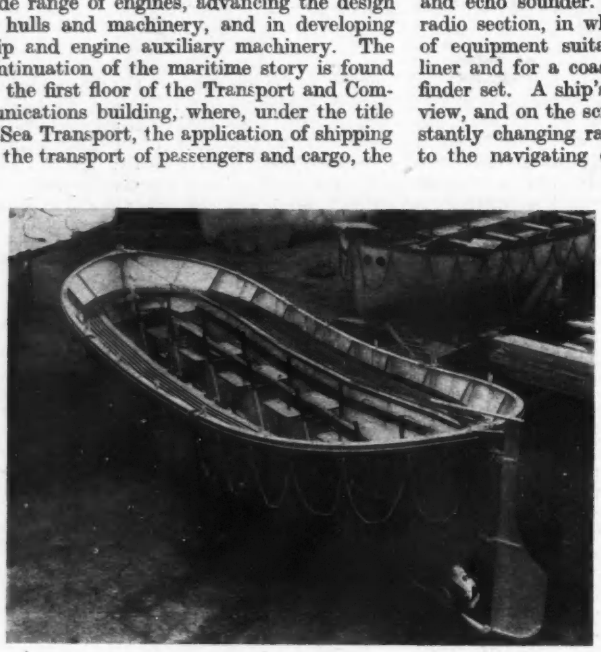
AN event of considerable significance is the creation of the post of seagoing scientific adviser to the staff of a Commander-in-Chief in the Royal Navy and the decision to make such an appointment reflects the Admiralty's determination to strengthen the link between the scientist and those who actually sail the ships, and to ensure that science plays its full part in operational planning. The first officer to be selected for the new post is Mr. R. J. Gossage, a principal scientific officer in the Royal Naval Service. His appointment to the Director of Operational Research and as Fleet Scientific Officer to the Commander-in-Chief, Home Fleet, is dated May 21st, and it is expected that he will take up his duties when the fleet visits Rosyth at the end of this month. Mr. Gossage, who is by training a physicist, joined the Admiralty scientific staff in 1939 and was actively engaged on counter measures to the magnetic mine. He has made a study of the magnetic and electromagnetic phenomena associated with ships, and his last appointment was in the department of research programmes and planning at the Admiralty. Mr. Gossage has acquired a background knowledge of naval operations and staff duties by attending the Royal Naval Staff Course at the R.N. College, Greenwich, and the Joint Services Staff Course. With his wide knowledge of the policy governing naval research and development and his insight into future plans, he should be able to make a valuable contribution to the solution of future naval problems.

The South Bank Exhibition

No. IV—*(Continued from page 639, May 18th)*

Sea Transport

IN the Sea and Ships Pavilion the theme is mainly one of achievement in building ships, either of wood or steel, constructing a wide range of engines, advancing the design of hulls and machinery, and in developing ship and engine auxiliary machinery. The continuation of the maritime story is found on the first floor of the Transport and Communications building, where, under the title of Sea Transport, the application of shipping to the transport of passengers and cargo, the handling of freight, the working of docks and harbours, methods of navigation, and safety at sea are demonstrated.



Aluminium Alloy Lifeboat

Over the full length of the space extends a series of cases containing longitudinally sectioned models of ships, which serve to show the improvement in passenger amenities from the days of sail up to the present. Typical of the fast sailing ships is the barque "Favell," followed by the "Britannia," which was the first Cunard liner, and then by the "Great Britain." The "Great Eastern," built in 1858, which was the forerunner of the large luxury liner and for over thirty years the world's largest ship, is contrasted with the "Aquitania" (built in 1914), which so recently passed into the ship-breaker's hands. Next there is the "Bloemfontein Castle," which made her maiden voyage, in the round Africa service of the Union Castle Line, in April, 1950, and is an excellent example of a modern passenger and cargo motor liner. Two models represent the present-day merchant ship. One is the "Wanstead," owned by Watts, Watts and Co., Ltd., which, in addition to being an efficient cargo ship, is noteworthy on account of her very comfortable living spaces for officers and crew and the radical departure from the usual lay-out. The second merchant ship is typical of a completely refrigerated vessel engaged in carrying meat, fruit and dairy produce. The last model is of a special-duty ship, and the "Monarch," which is in the service of the Post Office, was designed for, and is solely engaged in, the laying and repairing of submarine telegraph and telephone cables.

A display arranged to create the atmosphere of a ship's bridge emphasises the art of navigation. The bridge front is equipped with sliding windows and a "Kent" clear-view screen, and there are assembled actual examples of the instruments usually found in the wheelhouse, such as steering control gear, rudder indicator, compass, gyro compass, engine-room telegraphs, pitometer log, and echo sounder. Behind the bridge is a radio section, in which are full-size exhibits of equipment suitable for a medium-sized liner and for a coaster, and also a direction finder set. A ship's radar display is also on view, and on the screen can be seen the constantly changing radar picture as presented to the navigating officer of a ship voyaging from London to Antwerp. The course steamed by the ship is shown on a large chart by an illuminated track.

The many aspects of safety at sea, particularly linked with the work of Trinity House and the Royal National Life-Boat Institution, are demonstrated, and reference has already been made to the "Middle Ground" buoy shown near the Sea and Ships Pavilion. A series of photographs illustrates the work of buoy recovery and an illuminated model shows the use of various forms of buoys and the working of the "Rule of the Road" at sea. A model of a lightship and related exhibits, which include a foghorn, an example of modern dioptric lenses and the latest lighthouse lamp, together with photographs of the performance of routine tasks, show the activities of Trinity House in its work of maintaining navigational aids and pilotage.

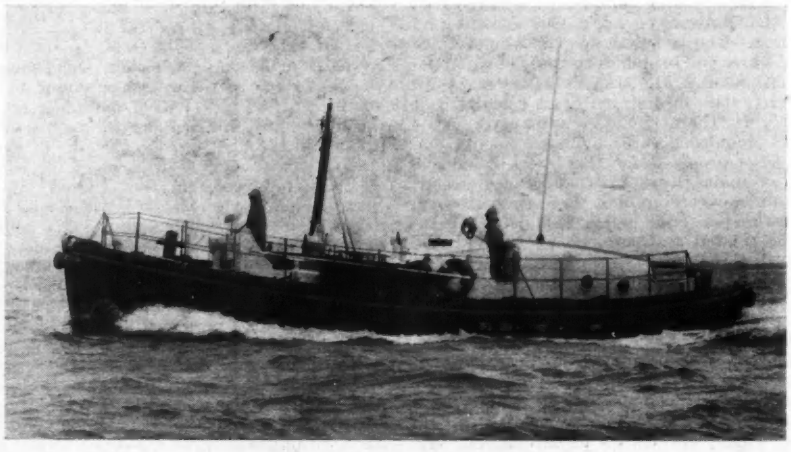
A selection of the equipment usually carried for saving life at sea is on view, including a Schermuly line-throwing pistol apparatus, flares and an automatic wireless transmitter. Suspended in davits outside the building is an example of the modern form of ship's lifeboat constructed in aluminium alloy by Mechans, Ltd. This boat, of which we reproduce a photograph taken before leaving the builder's works, has dimensions 30ft by 10ft 6in by 4ft 7in and weighs 48 cwt. It is fitted with Fleming hand propelling gear in place of oars and is certified by the Ministry of Transport to carry ninety-two persons.

For the saving of lives from the shore the Royal National Life-Boat Institution maintain a number of lifeboat stations, each of which is equipped with a boat belonging to one of the six standard designs. Two models are shown; one is named "Albert Edward" and is of a pulling, self-righting boat, presented in 1877 and the other is of a "Watson," motor lifeboat, 41ft in length and weighing 15 tons. On an outside site is a Watson cabin type motor lifeboat named "Sir Godfrey Baring," which is 46ft 9in in length by 12ft 9in beam. She has a service weight of 22½ tons. One of the accompanying illustrations shows the lifeboat on trial. The hull has an aluminium alloy superstructure, is fitted with 220 air cases and is divided into nine watertight compartments; one forms the engine-room, in which are fitted two 40 b.h.p. diesel engines, each made watertight so that they can continue running should the engine-room be flooded. The power of the engines is sufficient to give a speed of 8½ knots and the amount of fuel carried is enough to enable the vessel to cover 230 miles at full speed. Included among the equipment is a radio telephone, electric searchlight, line-throwing pistol, and an oil spray. There is a deck cabin and also a cabin below decks, and besides carrying a crew of eight the boat can take on board ninety-five people.

Docks and Harbours

An animated model of the port of Southampton, made to a scale of 1in to 50ft and measuring 26ft 9in by 12ft, serves to illustrate the working of a great port. Here are miles of railway lines and quays, numerous wet basins and dry docks, large transit sheds and harbour installations consisting of hundreds of cranes necessary for the expeditious loading and unloading of ships. Southampton has been a port from the earliest times and has witnessed the landing of Roman legions, the sailing of Henry V and his army for Agincourt, and the departure of the pilgrim Fathers in the "Mayflower." The rise of the port to its present-day dimensions dates back to 1836, when the Southampton Dock Company was formed; the laying of the foundation stone of the old docks took place in 1838.

The port is approached by a dredged channel, 600ft wide with 35ft of water at



Lifeboat "Sir Godfrey Baring"

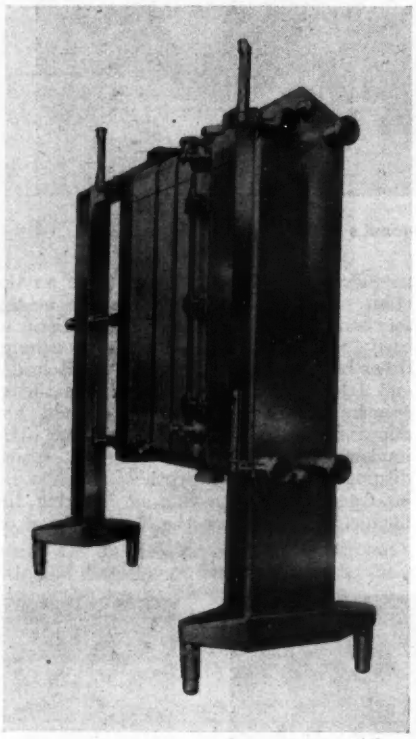
low water spring tides. It enjoys the natural advantage of the phenomenon of a double tide, which is of immense value for dry docking, and a tidal range of 13ft on spring tides, which makes closed docks unnecessary. The port consists of the Old Dock, Outer Dock, Inner Dock, Itchen Quays, Empress Dock, Test Quays, Ocean Dock, and New Docks. The latter are capable of berthing simultaneously eight of the world's largest liners. There are seven dry docks, the largest having a length overall of 1200ft, a width at entrance of 135ft and a depth of sill below datum of 37ft 6in. Some thirty-five of the principal shipping companies maintain services between Southampton and all parts of the world, and among the larger ships using the port are "Queen Elizabeth," "Liberté," Nieu Amsterdam." "America," "Pretoria Castle," "Andes," and "Willem Ruys."

It is recorded that 7980 passengers used the port in 1824, and the present magnitude of the undertaking is shown by the 1950 returns, which state that the total number of passengers was 532,120; the cargo handled amounted to 985,811 tons, and 15,959,811 gross tons of shipping entered the docks. Seen on the model, near the Ocean Dock, is the double-storey Ocean Terminal, which was opened last year to cater for the North Atlantic passenger trade. The link between ship and shore is by three twin turret-mounted, electrically-operated, light alloy, telescopic covered gangways, which can swing back to give clear passage to dock cranes. On the upper floor of the terminal are waiting halls, equipped with every facility for the passengers' comfort, and Customs examination halls. After the completion of formalities lifts and escalators transport the passengers to the ground floor, where there is a rail island platform from which the boat trains depart.

The Country Pavilion

The theme of the Country Pavilion at the South Bank Exhibition is "The Land and the People." It emphasises the dependence of the people upon the products of the land, and there is sufficient in the pavilion to demonstrate how effectively engineers and scientists are to-day co-operating with farmers and foresters to ensure that from the land of Britain there shall be produced as much as possible for the use of the people. In recent years engineers and farmers have combined to make the land of Britain as highly mechanised as any in the world. At the same time, farmers have shown increasing confidence in the work of scientists, whose researches have opened the way to many improvements in plant production and growth.

A tour of the Country Pavilion—made more or less in the order suggested by the Exhibition handbook—reveals, at the start, by means of wall charts and models, the diversity of British farming. There are depicted the areas, mainly north and west, where cattle rearing and grass and milk production are predominant, East Anglia and parts of the Midlands, which are noted for corn crops, the root crop areas of the Fens, and the fruit and hop gardens of Kent. The diverse nature of British farming, however, has not deterred engineers and scientists from taking a large part in solving the problems which it presents. That part of the Country Pavilion which is devoted to the application of research to agricultural and horticultural problems shows something of the work being done by such establishments as the Rothamsted Experimental Research Station on fertilisers and selective weed-killers, and the methods now employed to determine mineral deficiencies in various plants. In connection with the latter there is to be seen in operation a macerater, supplied by Townson and Mercer, Ltd., Croydon, which completely disintegrates vegetable matter prior to chemical treatment to discover its mineral deficiency. The macerater consists of a stainless steel shaft and cutters, driven by a ⅓ h.p. electric motor and capable of working at 10,000 r.p.m. The shaft is protected by a stainless steel cover, the lid of which is clamped to a specially lobed heavy glass jar when the instrument is ready for work. The "maceration," of course, takes place in the glass jar, and it is claimed that vegetable matter can generally be disintegrated to a smooth liquid in about four minutes. After the liquid has been chemically treated the extent of mineral deficiency is indicated by a photo-electric absorptionmeter, which has been supplied for the exhibition by Evans Electro-selenium, Ltd., Harlow, Essex.



"PARAFLOW" HEAT EXCHANGER—A.P.V.

Adjacent to this display, emphasising the importance of research in modern agriculture, there is a section devoted to rural crafts. With the progress of mechanisation, the number of truly rural craftsmen is declining, but engineers are not lacking in appreciation of the work of thatchers, saddlers, hurdle makers, basket makers, and weavers, which still occupies an important place in the life of the countryside, and which is still performed with a deftness of hand and comparatively simple tools. In this part of the Pavilion there are also displayed twelve coloured panels, painted by William Kempster and Barry Evans, to depict the country year, month by month. The panels which describe ploughing, cultivating, haymaking, corn harvesting, and potato lifting, all show the impact of mechanisation on agriculture. There is, however, no reference to the combine-harvester, which is now extensively employed in this country. The corn harvesting panel portrays a tractor-driven self-binder, with a tractor-driven thresher at work in the background.

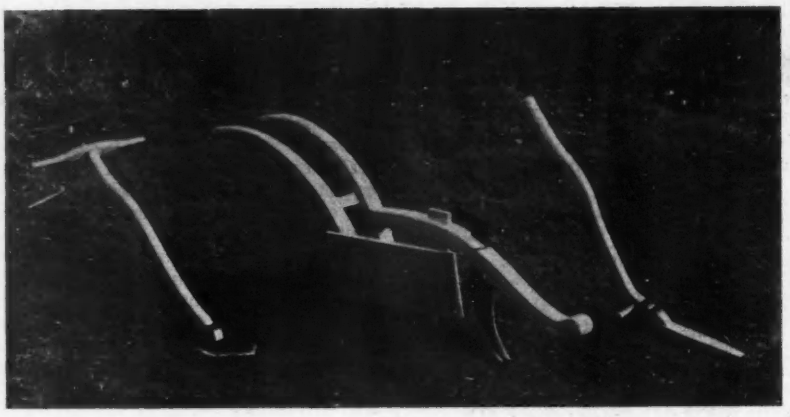
Milk production represents an important part of the British farming industry to-day, and it is a section of the industry in which there has been a great deal of research and progressive mechanisation in recent years. This has resulted in greatly improved standards of milk production, treatment and handling. The model dairy arranged in the Country Pavilion contains—in addition to dairy cattle—a milking machine unit provided by Alfa-Laval Company, Ltd., Brentford, and a variety of other equipment needed for the business of clean milk production. Among the latter is the "Paraflow" heat exchanger, illustrated herewith, and supplied by the A.P.V. Company, Ltd., Wandsworth Park, London, S.W.18. It is a device which is used for milk pasteurisation and consists principally of a number of pressed stainless steel plates, separated and sealed by rubber gaskets. A series of corrugations are pressed into each plate and have the effect, not only of increasing the area of heat transfer, but also of increasing turbulence in the flow and preventing the formation of heat insulating film. The machine can be sectioned up so that heating, regeneration, cooling, chilling, and filtering are all combined in one frame. The principal members of the "Paraflow" frame are fabricated in stainless steel, the follower and the plates being suspended on a rail which, with the bottom guide bar, bridges the head and end support. When the machine is closed, the plates are firmly clamped between the head and follower by a central tightening spindle which is hinged so that it can be dropped for quick opening when the screwed portion is withdrawn a few turns. The plates can then be slid back, each being individually and fully accessible for cleaning—an important point with milk processing, as such machines must be cleaned down daily. If desired, the exchanger can be equipped with a stainless steel two-chamber continuous filter, which is mounted integrally with the plates in its correct place in the sequence of operations. Each chamber contains a perforated double-walled cylinder, over and inside which the filter cloth is fitted. When the cloth needs changing a cock diverts the flow to the other chamber so that interruption is avoided. When pasteurising milk, of course, the "Paraflow" is employed with auxiliary equipment consisting of a control panel, holder, balance tank, pump, hot water set and air compressor.

Field Mechanisation

Although great advances in agriculture are being made through the application of science to soil treatment, crop production and cattle raising, the most spectacular progress is evident in the mechanisation of almost every operation in the field. The tractor is no longer merely a substitute for the horse. It provides the motive power for an increasing number of farm implements. Since the war tractor manufacturers themselves and many implement makers have designed and produced machines specially suited for operation with the power take-off of particular tractors. Such implements, however, by no means exhaust the range of machinery that is now available for the farmer's use in every season of the farming year. The implements displayed in the Country Pavilion are not fully representative of mechanised farming to-day—far more space would have been required—but they form a good cross-section of the products of British agricultural engineers.

The cycle of operations in the farming year begins with ploughing, one of the primary objects of which is to help to pro-

duce that physical condition of the soil known as good tilth, in which seeds readily germinate. The history of the evolution and development of the plough in this country is a fascinating study. At the South Bank Exhibition the history of the plough is admirably illustrated by eight half-scale models, which have been made by Preview, 288, Upper Richmond Road, London, S.W.15. An accompanying photograph shows three of these models. Reading



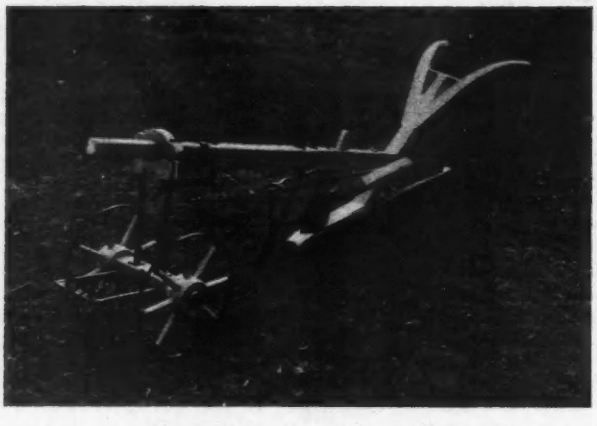
PLOUGH MODELS

from left to right, they are the breast plough, the mediæval plough and the caschrom. The first of these, the breast plough, was, in and prior to the eighteenth century, about the only implement available for skimming turf or rubbish from the surface of the soil. It seems likely that the implement was used to prepare the ground for ploughing proper. The breast plough most commonly used had a stout handle from 6ft to 8ft long, often with a downward curve near the blade end, and a fork at the handle end, the ends of which were mortised into a cross-piece, broad in the middle and with a rounded handle at either side. The blade was broadly pointed, about a foot long and 18in wide, the left side having a flange, turned up at right-angles, by which the edge of the slice was cut. According to *Change in the Farm*, by Hennell, the man who used the breast plough wore "beaters," made of patches of horse-hide, with strips of wood fastened lengthwise to them, to protect his thighs. By pushing against the cross-handle and exerting his weight, he forced the blade along for about 2ft, then turned the handles over and took a step forward for the next dig.

The mediæval plough, about which there is not a great deal of information, had a beam, coulter, share, mouldboard, and a pair of handles. The handles and share beam were made in one piece and, as is shown in the model, the coulter was bound to the beam with a thong. Mr. J. B. Passmore has drawn attention, in his book, "The English Plough," to the fact that the mediæval plough had an iron plate on the point of its share beam. The dip at the fore-end of the beam was characteristic of early wheelless ploughs. The caschrom, it has been stated, was in use in the Hebrides and Isle of Skye as late as the mid-nineteenth century by those who could not afford horses or oxen for ploughing. The implement acted like a narrow spade, digging a groove, the depth of which could be determined by raising or lowering the handle. When in use the handle rested on the ploughman's shoulder and he pushed forward the digger with a double jerk of his foot. The clod thus separated was thrown from left to right, the ploughman taking a step backward after turning each successive clod.

The other models are of Hertfordshire ploughs, the Rotherham plough, patented by Stanyforth and Foljambe, in 1730; a general purpose plough produced in 1900, and the Kent plough, of which an illustration is reproduced. The Kent plough was a one-way implement; that is, it was so constructed that it could turn a slice either to the right or the left. The plough consisted of a straight beam about 10ft long, mortised at its rear end into the stump, to which at either side the short, curved handles were fixed. The lower end of the stump was joined to a horizontal piece of wood, which formed the base of the plough, and to the forward end of which was fixed the iron socket carrying the share. The wheels were about 3ft high. According to Passmore, this kind of plough was in use in Kent as long as 300 years ago and is said to have been imported originally from the North of France.

Comparison of the models with the modern ploughs shown in the Country Pavilion emphasises the technical progress made through the years. The increasing power provided by the tractor has brought about many changes in ploughs and ploughing methods. Fields are much larger than they were in the days of the mediæval plough and the caschrom; marginal land is being successfully brought under cultivation. One of the modern ploughs in the Pavilion is the three-furrow "Fordson" disc, which has been introduced recently for working with the "Major" tractor by the Ford Motor Company, Ltd., Dagenham, Essex. This plough, a photograph of which is reproduced, is built up from heavy cast steel triangular segments and can be arranged for 10in or 12in wide ploughing. The depth is adjustable by means of two setscrews on the depth wheel stalk, and the depth wheel itself can be angled to overcome side thrust. The discs, which are made of hardened steel, are 26in in diameter. They are supported by heavy cast steel legs and run on taper roller bearings sealed against grit and dust. The rear furrow wheel, which is preset for angle towards the ploughed land, has a knife edge, which bites into the furrow wall and thus prevents crabbing. The front furrow width is adjustable by loosening two bolts and sliding the cross-shaft laterally, the plough being levelled by adjustment of the levelling box on the three-point linkage of the tractor. The weight of the plough is 948 lb.



MODEL OF KENT PLOUGH

MOUNTED DISC PLOUGH—FORDSON

Another recent development in plough design has led to the production of the reversible plough. The plough of this class, on view at the exhibition, is that which has been designed at the National Institute of Agricultural Engineering, Silsoe, Bedfordshire, and made by Fisher, Humphries and Co., Ltd., Pershore. It is a two-furrow plough, strongly built with a tubular steel frame of the open diamond pattern to accommodate the plough breasts. Furrow adjustment and a levelling device are incor-

porated and lift and tripping are done simultaneously, with the plough self-locking after the trip. The plough has an under-beam clearance of 21½in and the turning movement is longitudinal. In moving end over end the implement is assisted by rolling skids placed fore and aft.

For precision cultivation in row crops, steerage hoes are being increasingly used on the farms of this country. The example of this class of implement which has been given a place in the Country Pavilion is made by Harry Ferguson, Ltd., Coventry, for working with the Ferguson tractor. An accompanying illustration shows the hoe, which can be used in row widths from 18in to 24in. The cultivator frame is 94in wide and is constructed of lightweight, high-strength steel angle bar. Four rows can be cultivated simultaneously, there being 1in adjustment of the blades by means of holes in the frame. The standard equipment of the hoe includes five centre shovels, eight side shovels and eight discs, and tiller type steerage, controlled by an operator seated on the implement, has been provided. The steering, incidentally, is limited by check chains to 5in either side of the tractor centre line. The hoe is mounted to the tractor by the Ferguson three-point linkage, and its working depth is controlled by a finger-tip hydraulic control lever, it being possible to adjust the discs, side shovels and centre shovels independently by raising or lowering them in the stem seats.

STEERAGE HOE—FERGUSON

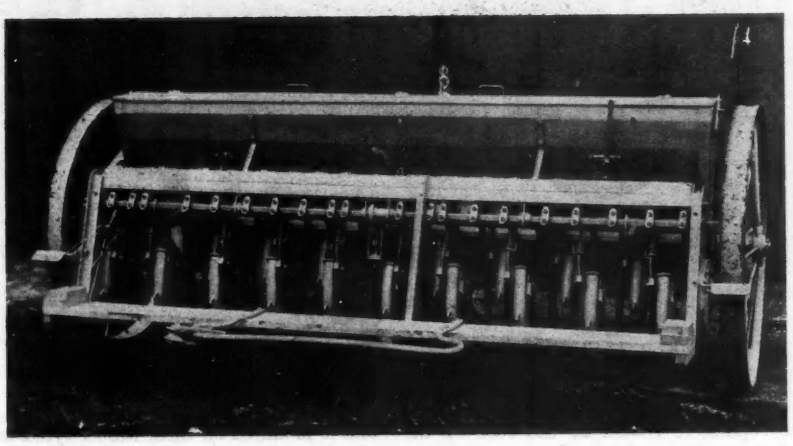
In mechanising agriculture the special requirements of market gardeners and smallholders have not been overlooked. Several light tractors, with handlebar control, are now being made in this country. One of them is the "Hoemate," illustrated on this page, and supplied for exhibition by its manufacturers, B.M.B. Products Division of Brockhouse Engineering (Southport), Ltd Crossens, Southport, Lancs. It is a general-purpose machine powered by a B.M.B. 1¾ h.p. single-cylinder, two-stroke, air-cooled petrol engine, the transmission being through machine-cut gears, running in oil, with bronze bearings and mounted in a dust-proof case. The clutch lever and throttle control are on the handles of the tractor. With 20in diameter rubber-tyred wheels, the "Hoemate" has a speed of 1 to 2⅛ m.p.h., and there is track adjustment from 14in to 21in. This tractor, which weighs 196 lb, can be equipped with a variety of implements, including a plough capable of turning over soil to a depth of from 5in to 7in, disc harrow, furrow openers, hoe blades, and grass mower. In addition, a power take-off is provided, thus enabling the tractor to be used as a mobile power unit.

HOEMATE TRACTOR—B.M.B. PRODUCTS

After the preparation of a satisfactory tilth the farmer proceeds to the business of seed drilling, which is now another fully mechanised operation. A seed-drilling machine was introduced in this country by Jethro Tull as long ago as 1731, but in a much later day than that farmers scattered grain such as wheat, oats and barley by hand. After sowing in that way, the land was harrowed and the seed was more or less covered, but it was obviously impossible to ensure that all the seed was buried at a uniform depth, or, indeed, that it was buried at all. The modern grain drill is a machine which ejects measured quantities of seed in even streams directed through tubes to the ground. These delivery tubes are fitted to coulters which scratch narrow and shallow trenches in the seed bed. The seed is thus practically all buried at a uniform depth, and as the coulters are spaced at equidistant intervals, it is spread uniformly over the field.

One of our illustrations shows the "Albion" combined grain and fertiliser drill, which is exhibited in the Country Pavilion. It is a product of Harrison, McGregor and Guest, Ltd., Leigh, Lancs, and can be arranged to work sixteen rows or twelve rows at a time. The drill is a tractor-operated machine, and as its purpose is to deposit both seeds and fertiliser, there are two separate hoppers, the interior of that carrying the fertiliser being specially treated against the corrosive effect of this material. The grain and fertiliser are conducted to the coulters by separate tubes by force feed-sowing mechanism. This mechanism consists of a shaft fitted under the hoppers, on which there are mounted a number of fluted rollers, one for each coulter. The rollers rotate with the shaft, the grain and fertiliser flowing on to them by gravity. The "Albion" is provided with a depth adjuster, the maximum depth at which grain can be sown being 4in.

The more extensive use of all kinds of artificial fertilisers has resulted in the production of various forms of manure distributor. A photograph on the next page shows a machine made for this purpose by Massey-Harris, Ltd., Stretford, Manchester. Its sowing width is 15ft 6in, and it has three boxes for carrying the fertiliser, their total capacity being 15·75 cubic feet. The centre box is rigid and the two outer ones are movable to fold sideways, for transport purposes, as indicated by the illustration. The distributor is mounted on four rubber-tyred wheels, and the method of delivery has been designed so that the front wheels do not pass over the sown fertiliser. Dustproof pressure-lubricated



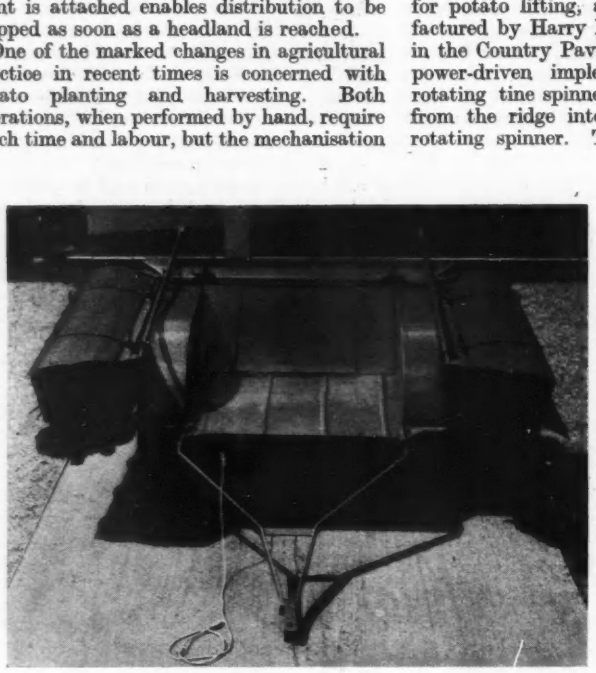
"ALBION" GRAIN AND FERTILISER DRILL—HARRISON McGREGOR

bearings are provided for each delivery disc, and the in and out-of-gear mechanism controlled from the tractor to which the equipment is attached enables distribution to be stopped as soon as a headland is reached.

One of the marked changes in agricultural practice in recent times is concerned with potato planting and harvesting. Both operations, when performed by hand, require much time and labour, but the mechanisation of those operations has not been easily achieved. Research both on potato planters and harvesters continues, and several kinds of each machine are now being manufactured. A three-row potato planter shown at the Exhibition is the "Robot," illustrated herewith, and made by Transplanters (Robot), Ltd., Sandridge, Herts. It is a tractor-mounted implement driven from the power take-off. The standard hopper provided for the machine holds 4 cwt of potatoes, and three operators seated at the rear of the implement direct the seed to a series of hinged feeder cups. Five cups are always before each operator. The drive from the power take-off of the tractor is transmitted to a 40 to 1 reduction gearbox, sprockets giving spacings in planting of approximately 10in, 12in, 16in and 20in. Row widths of 24in to 30in may be obtained by moving the two outer planting units, and, to the toolbar at the rear of the implement, ridge coverers or discs can be attached as desired. In addition, the "Robot" machine can now be equipped for fertiliser distribution, while the potatoes are being planted.

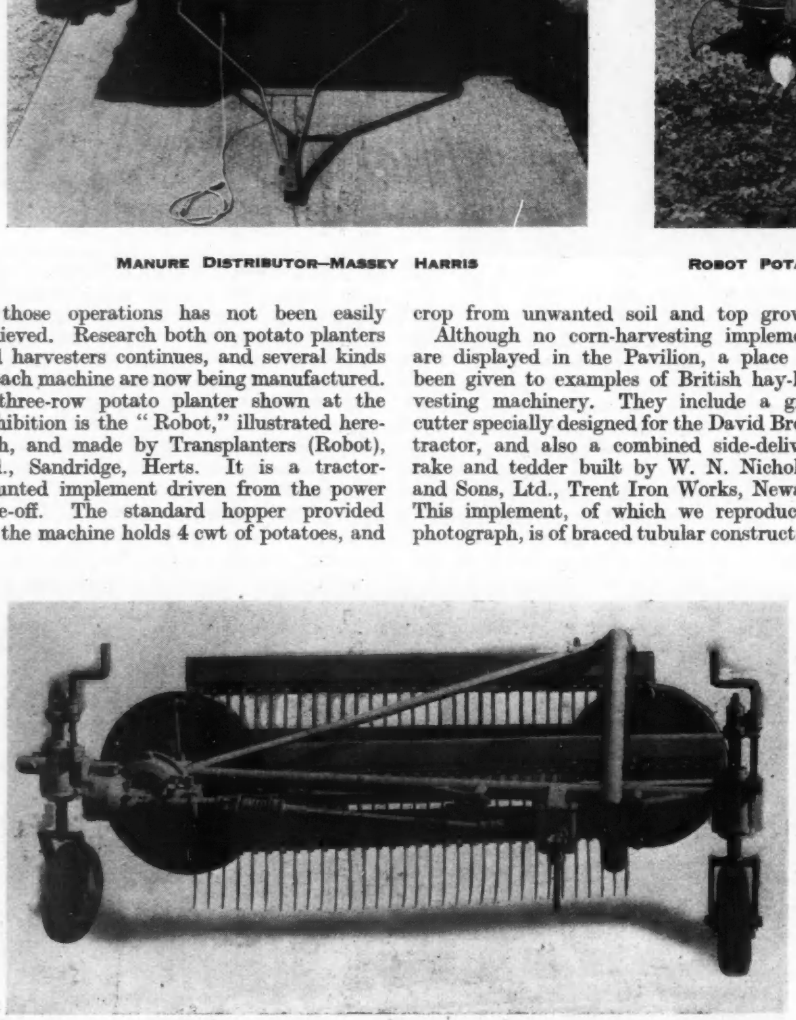
As an example of the machines available for potato lifting, a potato spinner, manufactured by Harry Ferguson, Ltd., is shown in the Country Pavilion. It is a single-row, power-driven implement, with an initial rotating tine spinner which throws potatoes from the ridge into the path of a second rotating spinner. The latter separates the crop from unwanted soil and top growth.

Although no corn-harvesting implements are displayed in the Pavilion, a place has been given to examples of British hay-harvesting machinery. They include a grass cutter specially designed for the David Brown tractor, and also a combined side-delivery rake and tedder built by W. N. Nicholson and Sons, Ltd., Trent Iron Works, Newark. This implement, of which we reproduce a photograph, is of braced tubular construction and is mounted on three rubber-tyred castor wheels. It is attached to a tractor by the two bottom links of a three-point power lift, although the power lift itself is not used. The rake bars are driven, through totally enclosed machine cut gears, from the power take-off shaft of the tractor, the rake being able to cover two swaths cut by a 5ft mower. When in work the tractor is attached towards the near side of the rake so that the tractor wheels straddle one of the swaths to be dealt with. The overall transport width of this machine is 7ft 6in.



MANURE DISTRIBUTOR—MASSEY HARRIS

ROBOT POTATO PLANTER—TRANSPLANTERS (ROBOT) LTD.



COMBINED SIDE RAKE AND TEDDER—NICHOLSON

A complete tour of the Country Pavilion at the South Bank Exhibition must include inspection of the modern smithy. The village blacksmith of past days was a craftsman who turned his hand to many tasks in addition to making and fitting horseshoes. He could be relied upon for repairs to such tools and implements as the farmer then used. The decline of the horse population has now reduced the demand for horseshoes, but blacksmithing is still an important trade. The equipment of the smithy in the Country Pavilion demonstrates not only the versatility but the up-to-dateness of the present-day smith. It includes, in addition to the familiar hearth, anvil, vices and hand tools, such items as acetylene and electric welding sets, an oxygen cutting machine, and portable drills and grinders.

(To be continued)

Technical Reports

Purification of the Water of Swimming Baths London: H.M. Stationery Office. Price 1s. 6d.—This report has been prepared by a committee of the Ministry of Health. It opens with a description of possible sources of pollution of swimming baths and recommends measures which bathers should take to ensure cleanliness. There is then a description of purification systems, covering continuous flow, natural purification, fill and empty without a treatment system, treatment by chemical means without filtration, and continuous filtration. The continuous filtration method is then developed in some detail, and there are chapters on sterilisation and alkalinity.

Pavement Design for Roads and Airfields. By E. H. Davis, B.Sc. Road Research Technical Paper No. 20. D.S.I.R. London: H.M. Stationery Office. Price 1s. 9d.—A great deal of investigation has been carried out during the last quarter-century to try to determine a rational method of designing pavements for roads and runways. It is pointed out in the preface of this report that no less than thirty attempts have been recorded by the Road Research Laboratory, and others are known to exist. The report gives a critical review of the principal methods of design, assessed in the light of practical data obtained by the Laboratory from investigations in the field.

Despite all efforts no completely logical method of design has yet been evolved; it is doubtful, in fact whether an ideal solution will ever be possible. Even the best of modern methods remain obstinately empirical in the sense that the values assigned to one or more terms in the formula are chosen so as to ensure that the answer shall conform with the dictates of practical experience. Nevertheless, at least two methods—the "C.B.R." method and the "shear strength" method—are, in the opinion of the Road Research Laboratory, sufficiently near the mark to be valuable as instruments in preparing specifications for road and airfield pavements. The report indicates the lines along which further research may improve the accuracy and reliability of these methods.

International Motor Show at Frankfurt

No. I.—PASSENGER CARS

THE International Motor Show at Frankfurt/Main, which took place from April 19th to 29th, was the first German Motor Show organised since the war, and attracted more than 600,000 visitors. Exhibits occupied a park covering 17 acres, of which 10 acres were covered halls, some of them new buildings erected after the war. The international character of the Show was maintained by twenty foreign firms exhibiting thirty-eight models, mainly passenger cars, among them being a strong British contingent representing the Nuffield group, the Rootes Organisation, Austin and Ford.

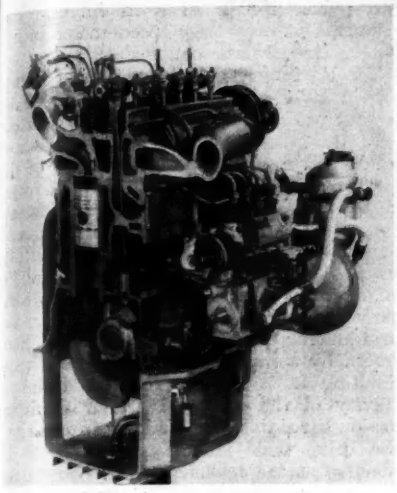


FIG. 1—MERCEDES-BENZ FOUR-CYLINDER DIESEL ENGINE

The Frankfurt Show demonstrated the progress which the German motor industry has achieved in the last four or five years. At the end of the war the majority of motor factories—with the exception of the Ford Works in Cologne—were virtually in ruins, along with the industry producing parts and accessories. Less than 1300 passenger cars were built in 1945, all of them "Volkswagen" for the use of the Allied Occupation Forces. Daimler-Benz made thirty passenger cars in 1946, and only twenty new Opel cars left the plant in Ruesselsheim in 1947. Production remained dormant until the middle of 1948, but began to rise rapidly after the currency reform; in 1950 the total production (road tractors excluded) amounted to about 305,000 units. A statistical survey (Table I) gives details of the production in 1949 and 1950 as compared with the pre-war production.

The rebuilding of the German motor industry, of course, has been aided largely by foreign credits and by assistance received under Marshall Aid.

The German automobile industry has changed considerably since the end of the war. The Auto Union, with its representative makes, "Audi," "Wanderer" and "Horch," has been particularly affected, as all its works are now situated in the Eastern Zone, and it was not able to resume production of the well-known "DKW" car until the middle of last year. Hanomag and B.M.W. also have not yet gone into full-scale production, and were represented at the Show only by the first prototypes, while Adler, Stoewer and Maybach were not represented at all. Some new firms have taken up the production of motor vehicles since the end of the war, some with marked financial success, so that, numerically at least, there are more automobile factories in the Western Zone now than there were in the whole of Germany before the war. The great majority of vehicles, however, are being made by Daimler-Benz, the Volkswagen works, Ford and Opel, the latter two firms being under the control of the American Ford Company and of the General Motors Corporation.

Daimler-Benz, who at the beginning of this year commemorated the fiftieth anniversary of their trade name "Mercedes," is still a strong concern, although all the works had suffered from extensive bomb damage. It has now fully completed its major reconstruction programme and is actively engaged in re-equipping the plant to meet increasing production requirements. The company now employs more than 25,000 people and last year produced some 42,000 vehicles, an increase of 82 per cent over the total production of 1949. This figure actually surpassed its peak pre-war production, though the production of passenger cars, as against commercial vehicles, had so far been limited to three types of practically uniform design, all of them fitted with 1·77-litre four-cylinder engines.

These cars—basically of pre-war design—have become popular mainly because of their springing and road-holding properties. They have maintained the Mercedes reputation and are moderately priced. A car of particular interest to the engineer is the type "170 D," a vehicle fitted with a light diesel engine (Fig. 1), which has endeavoured to combine the economy of an oil engine with the smoothness of a petrol engine.

To these medium-sized cars two new six-cylinder models have now been added—a 2·2-litre car (type "220") and a 3-litre car (type "300"), both of them moderately styled with only slight evidence of American influence. The new cars maintain the characteristic features of the "170" series: the X-shaped frame consists of two oval tubes with a centre reinforcement and welded-in tubular cross members; it offers a high

TABLE I

Type of vehicle	1938 Germany	1949 West Germany	1950 West Germany	Production 1950 per cent of 1938	Production 1950 per cent of 1949
Passenger cars	276,804	103,998	216,122	78·1	207·8
Utility cars	—	—	3,283	—	—
Delivery vans up to 1 ton	—	24,049	42,923	—	178·5
Goods vehicles up to 4 tons	—	25,747	32,515	—	126·3
Goods vehicles, 4 tons and more	—	4,954	6,245	—	126·1
Goods vehicles total	80,199	54,750	81,683	106·6	149·2
Motor buses		2,710	3,812		140·7
Trolleybuses		79	30		38·0
Road tractors	—	1,986	1,131	—	56·9
Total	—	163,523	306,061	—	187·2
Total (without road tractors)	357,003	161,537	304,930	85·4	188·8

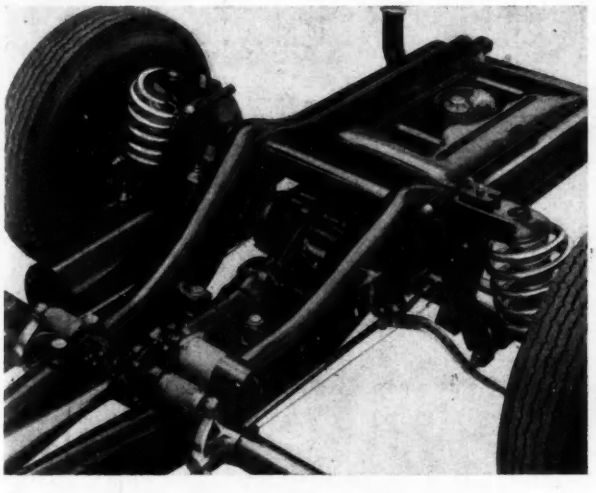


FIG. 2—MERCEDES-BENZ REAR AXLE SUSPENSION WITH PUSH-BUTTON CONTROLLED SUPPLEMENTARY SPRINGING

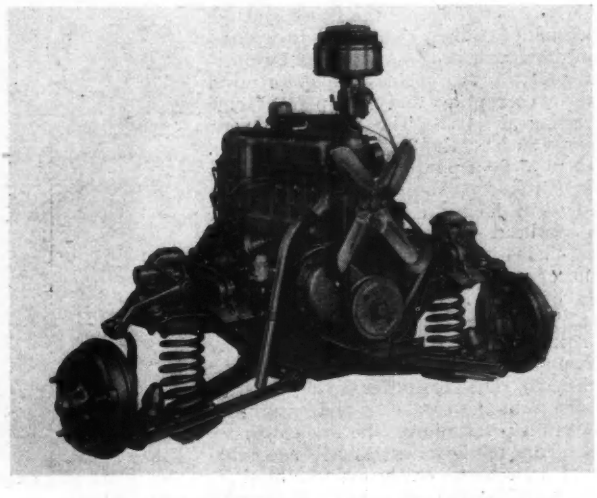


FIG. 3—ENGINE AND FRONT WHEEL SUSPENSION OF OPEL "KAPITAEN"

degree of resistance to torsional deflection with a comparatively low weight. The front wheel suspension is of the now almost universal pattern, employing wishbones of uneven length with coil springs and telescopic dampers. The independent rear suspension consists of a rear axle housing (with hypoid gear) fixed to the frame in flexible rubber mountings and two swinging half-axles, supported by coil springs and

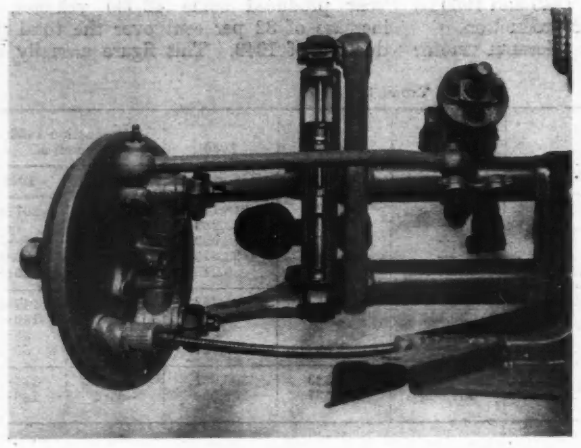


FIG. 4—FRONT WHEEL SUSPENSION OF THE "VOLKSWAGEN"

fitted with telescopic dampers. An interesting device has been incorporated in the 3-litre car for the purpose of keeping the spring rate and the camber angle of the rear wheels practically constant irrespective of the passenger load carried. In case of great load the rear springing is stiffened by extending a transverse bar, forming an abutment for two supplementary torsion bar springs mounted parallel with the frame and linked to each wheel (Fig. 2). The mechanism is brought into action by a small electric motor operated by push-button control from the instrument board.

Whereas the design of the frame and the suspension of the new cars is mainly a consequent development of the orthodox Daimler-Benz practice, the engines are quite novel in their conception and incorporate some interesting details. The 2·2-litre engine develops 80 h.p., the 3-litre engine 115 h.p. at about 5000 r.p.m. They have a short stroke (stroke/bore ratio 0·9 in the 2·2 litre and 1·04 in the 3-litre engine) and are fitted with overhead camshafts, driven by duplex roller chains and operating the valves by means of rockers. The cylinder heads are made of light metal with inserted valve seats. The water jacket of the cylinder block has been extended downwards almost to the oil sump flange (in the centre plane of the crankshaft), thus greatly improving the heat transfer from the crankcase and ensuring a uniform temperature over the whole cylinder block. An oil heat exchanger, accessible through wide covers on the cylinder block, is fitted inside the water jacket. The water temperature is thermostatically controlled, and a spring-loaded by-pass valve in the oil circuit allows the oil, as long as it is still cold, to be discharged via an oil gallery direct to the cylinder walls, thus assuring adequate cylinder lubrication during the critical warming-up period. A vacuum timing control, operated from a diaphragm in the inlet manifold, has been fitted in addition to the centrifugal timing device to obtain maximum torque and economy under part-throttle conditions.

The power/weight ratio of the two new cars (60 h.p./ton in the 2·2-litre and 63 h.p./ton in the 3-litre) is higher than that of most European cars. During a short ride their general performance, i.e., road-holding, springing, reliability in curves, &c., proved to be good. It was possible to drive these cars in top gear at practically all speeds with flexibility and with satisfactory acceleration.

The Opel Works, an associate firm of the General Motors Corporation who obtained control of the company in 1928, now employ about 20,000 people. Although it lost its modern factory for commercial vehicles in Brandenburg (Russian Zone), it was able to increase production to 72,700 vehicles in 1950 and is aiming to raise this figure to 95,000 in 1951. The export figure amounts to 40 per cent of its total output and is the highest throughout the industry.

Opel production of passenger cars is confined to two models, the four-cylinder, 1·5-litre "Olympia" and the 2·5-litre "Kapitaen," both of conventional design with integral all-steel body and live rear axle. In size, weight and general conception they are not unlike the British Vauxhall cars. Apart from a new styling and larger section tyres, they show only minor deviations from post-war models. The Dubonnet front-wheel suspension, however, which was used in the "Olympia" before the war, has been replaced by a wishbone system with coil springs and double-acting shock absorbers, and the engines have been completely redesigned. The four cylinders have a bore of 80mm and a stroke of 74mm; the six cylinders have the same bore, but an 82mm stroke. The cylinder block and cylinder head of these engines is ingeniously designed; it seemed that not only is the cylinder axis offset by 1·5mm relative to the crankshaft axis, but that the gudgeon pin is off-centre to the piston axis by the same amount. At the comparatively low compression ratio of 6·15 for the four-cylinder and 6·25 for the six-cylinder engine the output of 39 h.p. and 58 h.p. respectively must be considered quite satisfactory. Fig. 3 shows the six-cylinder engine and the front wheel suspension.

In order to obtain an improved steering geometry and less tyre wear the "Kapitaen" has been fitted with a centre-point steering system, the tie rods of which consist of two identical parts. A torsional front wheel stabiliser and telescopic dampers at the rear axle, slanted at 45 deg., increase side stability and reduce rolling to a minimum. The arrangement of a large speedometer in full view of the driver is commendable.

The Ford Works in Cologne, with an output in 1951 of about 30,000 vehicles, is at present producing one kind of passenger car only, the 1·2-litre "Taunus," the chassis of which is almost identical with that of the Dagenham-made Ford "Prefect." The style of the body, a two-door saloon is different, however, and shows clearly a concession to the more fastidious Continental taste. In the 1951 model of the "Taunus Special," a luxury version of the "Taunus," this company has made some effort to improve the road-holding properties of the older Ford design by a modification of the front axle, resulting in a lowering of the centre of gravity of the car by 1in, and by fitting torsion bar stabilisers. Judging from a short test drive these modifications seem to be effective as the tendency of the car to roll excessively in curves, in consequence of the transverse spring arrangement, has been noticeably reduced. The "Taunus Special" is equipped with steering column gear shift.

The youngest, but as far as output is concerned, the most productive German automobile factory is the Volkswagen Works at Wolfsburg, originally built and financed by the German Labour Front Organisation for the purpose of making "The People's Car" and finished shortly before the war. It produced about 55,000 open military utility cars and 15,000 of the amphibian version during the war. Full-scale peacetime production did not start until the middle of 1947 and rose rapidly from less than 9000 cars produced in that year to more than 90,000 in 1950.

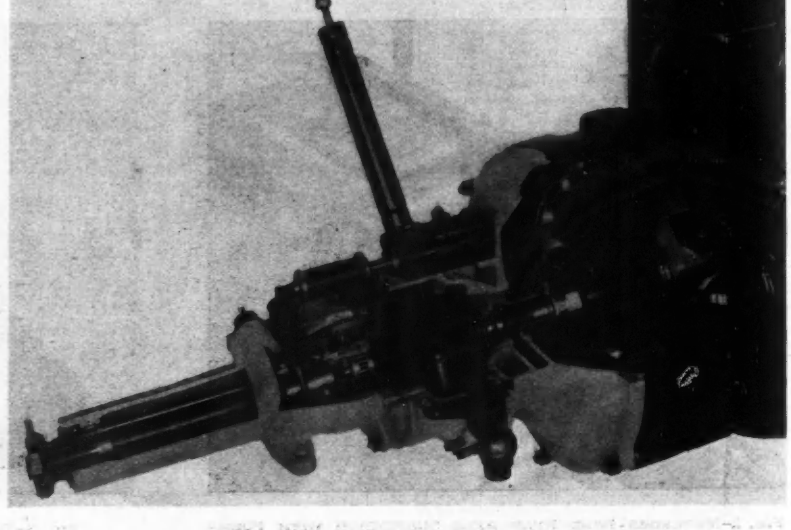


FIG. 5—HYDRAULIC TRANSMISSION OF THE BORGWARD "HANSA"

Designed and developed after years of extensive experimental work by the late

Dr. Porsche, the "Volkswagen" was meant to sell at approximately £90, a price which hardly bore any actual relation to the cost of production, but was obviously to be subsidised from funds of the Labour Front. To-day the "Volkswagen" standard model sells for £380, the better equipped export model for £440, and, as far as price per weight goes, is on a par with the sales price of other German motor-cars. Although this car is no longer a novelty, a short description of its design may be of interest.

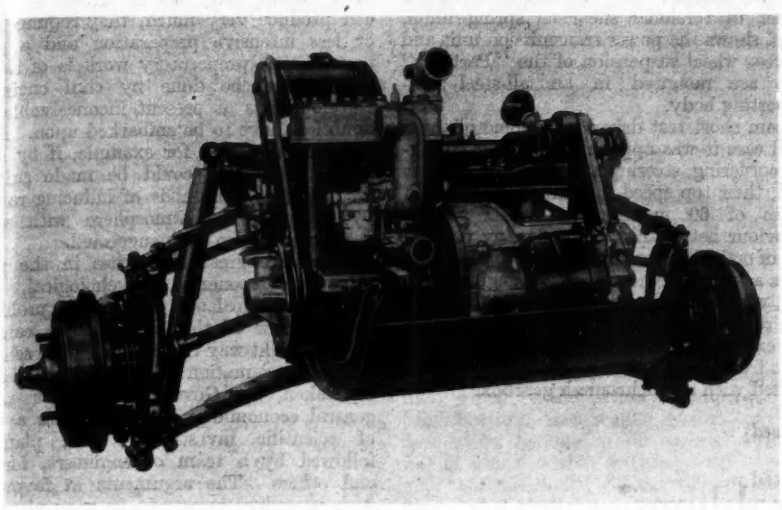


FIG. 6—POWER TRANSMISSION UNIT OF THE "GOLIATH"

The 1·1-litre air-cooled, four-cylinder engine of 75mm bore and 64mm stroke develops 24 h.p. at the low speed of 3000 r.p.m. It has two pairs of horizontally opposed cast iron cylinders, each cylinder pair being covered by one light metal cylinder head. The overhead valves are operated in the usual way by means of push rods and rockers. The short counterbalanced crankshaft is carried in four light metal bearings and the connecting-rods are fitted with steel-backed lead-bronze bearings. The air cooling of the engine is attained by means of a fan which is attached to an extension of the generator shaft and driven by a vee belt. An oil cooler provided with a by-pass valve is fitted inside the fan casing. The torque from the engine is transmitted to the non-synchronised gearbox, which is mounted ahead of the rear axle, and from the gearbox to the differential housing. The large universal joints of the two floating rear axle shafts are carried in the differential housing.

The chassis of the "Volkswagen" consists of two parts, the actual frame and the steel floor. These two pieces are spot welded together with the channel-shaped centre section of the frame, the forked rear end of which serves as support for the transmission and the engine assembly. The gear-shift rod, hand brake linkage, fuel pipes and the different cables for clutch, brake, throttle, choke and the heating tubes pass through the centre of the frame. The front suspension consists of two rigidly joined tubes, bolted to the front end of the frame, which carry the laminated torsion bars and the upper and lower parallel arms of the front wheel suspension (Fig. 4). The rear wheels also are independently sprung, using one individual torsion bar on each side. The body of the car is made of formed steel panels, electrically welded together and bolted to the frame. The fuel tank and the spare tyre are housed under the front bonnet, and a small luggage compartment is provided behind the rear seats.

The main improvement upon last year's models relates to the automatic control of the cooling air supply, consisting of a throttle ring at the inlet end of the fan, operated by a thermostat. Overheating of the engine, as well as excessive wear due to running under undercooled conditions is thus prevented. Other improvements comprise an effective silencer in the heating air circuit, hydraulic brakes (hitherto only fitted to export models) and telescopic dampers for the front wheels.

The "Volkswagen," which at its first appearance created something of a sensation, not least because of its rather unusual appearance, has achieved a well-deserved popularity, mainly because of its general performance and road-holding capacity, which outweigh such inconveniences as the greater noise of the air-cooled engine and the lack of a synchromesh gearbox. Of the total production of the "Volkswagen," 33 per cent is being exported, mainly to Holland, Switzerland and the Scandinavian countries, and the firm plans to increase its 1951 production to 120,000 units.

The Borgward Company, the only privately owned German automobile factory, which employs about 10,000 people, with its associated firms, Goliath and Lloyd, produced about 11,000 vehicles in 1950. Its 1·5-litre and 1·8-litre cars, "Hansa 1500" and "Hansa 1800," are vehicles of modern design, fitted with overhead valve engines, independent four-wheel suspension, and having an effective streamline shape. They were the only cars at the Show which can be fitted optionally with an automatic fluid drive. Our illustration Fig. 5 shows the Borgward hydraulic transmission unit which basically consists of a combination of a fluid flywheel with a simple single-stage torque converter. The torque ratio of the converter, about 4 to 1, is sufficiently high to dispense with an additional auxiliary gear, and the output shaft is positively engaged to the flywheel, by means of governor-controlled clutch, when the speed of the car exceeds about 25 m.p.h.

Neither the Ford "Taunus" nor the "Volkswagen" are regarded in Germany as "small cars," a term which nowadays is generally applied to cars of less than 15 cwt with engines of not more than 750 c.c. capacity. To judge from the number of exhibits in this particular class, the demand for a vehicle which is economical not only in fuel consumption, but in general running cost, must be very great indeed, though not surprising in a country where every 126th person only is the owner of a motor-car. With the exception of the "DKW Meisterklasse" of the Auto Union, which is a modified and restyled pre-war model, all the other small cars have been designed and built after the war, and it is interesting to note that in their basic conception they all follow an almost uniform pattern. All are fitted with water-cooled two-stroke engines of very simple form (port-controlled crankcase scavenging, lubrication by oil fuel mixture) with a cylinder capacity of something between 400 c.c. and 700 c.c. and developing up to 28 h.p. at 4000 r.p.m. In spite of certain shortcomings of the two-stroke engine, particularly its uneven running and its unsatisfactory torque in the low-speed range, these power units are very popular because of their inherent simplicity and reliability.

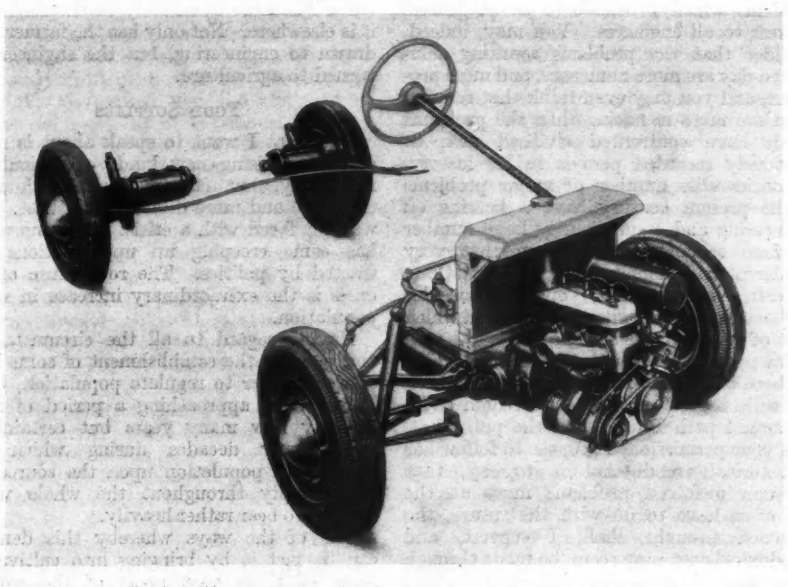


FIG. 7—HANOMAG "PARTNER" POWER TRANSMISSION UNIT AND REAR WHEEL SUSPENSION

The engines of the "Superior" and of the "Goliath" can be fitted with petrol injection

as an optional extra. The injection equipment, made by Bosch, consists of a small two-cylinder injection pump coupled with an oil pump, which discharges the lubricant into the air intake. The latter has a normal butterfly throttle and the fuel pump is controlled in the usual way by the vacuum in the air intake pipe. The fuel is discharged through a spring-loaded injector directly into the cylinder shortly after bottom dead centre.

Evidence so far available seems to indicate that petrol injection is likely to increase the maximum output, to improve the torque characteristic and, to a certain degree, reduce the fuel and oil consumption of a two-stroke engine. On the other hand, it is doubtful whether the results which are to be gained will justify the cost and complication involved, factors which cannot, as in the case of the oil engine, be offset by the elimination of the ignition system.

With one exception, the "Champion," which has a rear-mounted 400 c.c. engine, all the other cars are fitted with front-wheel drive and independent springing of all four wheels, which, in conjunction with a very low centre of gravity, provides a riding comfort superior to anything attainable in other cars of comparable weight. The engines are mounted ahead of the front wheels, either transversely, as in the case of the 600 c.c. "Goliath" (Fig. 6) and the 700 c.c. "DKW Meisterklasse" or longitudinally, as in the 600 c.c. Gutbrot "Superior" and the 700 c.c. Hanomag "Partner." The latter car is the only one equipped with a three-cylinder engine, and it employs rubber bushes in torsional shear as spring units. Fig. 7 shows the power transmission unit and the rear wheel suspension of the "Partner;" they are mounted in an all-steel self-supporting body.

From short test drives with some of these small cars it was apparent that their springing, cornering, steering and road holding was good, their top speed high (frequently far in excess of 60 m.p.h.), and their general behaviour better than that of many pre-war cars of orthodox design weighing two or three times as much. The two-stroke engine, however, with its inadequate torque at low speed requires frequent gear changing, a procedure not exactly facilitated by the fact that, apart from the Hanomag, none of these cars is fitted with a synchromesh gearbox.

(To be continued)

Engineers' Problems*

By G. A. MAUNSELL

AS you know, the procedure adopted in the case of the James Forrest Lecture is for the Council of the Institution to invite someone who may, or may not, be an engineer to deliver a lecture on a subject which the Council selects, and I greatly appreciate the honour of having been selected by the Council to address you on this occasion.

I shall endeavour to confine myself to problems which I believe to be of general interest to all engineers. You may, indeed, consider that the problems awaiting solution to-day are more numerous, and more profound, and you may even think that some of them are more menacing than the problems which have confronted civilised man at previously recorded periods in his history. A considerable number of major problems in the present century have a bearing on engineering and a surprisingly large number of them seem to derive from that very wonderful and comparatively modern thing we call science, indeed, you may consider that science is the fertile seed bed from which most of our problems spring.

Now, in dealing with the theme which has been allotted to me to-night, I have been left with a great measure of freedom as to the actual path I take, and the path that, with your permission, I propose to follow has a historical trend—that is to say, that although unsolved problems must on the face of it have to do with the future, the approach to-night shall, I suggest, and paradoxical as it may seem, be made through the past.

Before setting out on the path indicated I would ask your consent to linger on the threshold for a moment.

The dependence of agriculture upon engineering aids is one of those things which have been building up slowly over three or four generations. A hundred years ago the farmer produced the crops, raised the stock and disposed of his produce without outside aid. It is only quite recently, however, within the past ten or twenty years that the farmer in this country has become mechanically minded. He has to be so minded to-day because the extraction of a bare livelihood from the land, let alone the making of any profit is entirely dependent upon the extent to which mechanical aids are made use of and upon the skill with which they are employed by the farmer, and this is particularly true of this country where agriculture is more intensively mechanised than it is elsewhere. Not only has the farmer been drawn to engineering, but the engineer has turned to agriculture.

Food Supplies

But what I want to speak about is not a case of devising new kinds of agricultural machinery, but is something much more extensive and more difficult than that. The world is faced with a crisis. It is one which has come creeping up upon nations distracted by politics. The root cause of the crisis is the extraordinary increase in world population.

Having regard to all the circumstances, and pending the establishment of some kind of world order to regulate population, there seems to be approaching a period of none can say how many years but certainly a good many decades during which the pressure of population upon the sources of food supply throughout the whole world is likely to bear rather heavily.

One of the ways whereby this demand can be met is by bringing into cultivation some of those vast areas of the world's surface which cannot now be made use of. Anyone who has had to take transcontinental journeys by air is bound to be impressed by the limited areas of the earth's land surface which are under cultivation and the comparatively large areas which are not. There are, for example, mountainous areas where there is little or no soil and where it is too barren for crops to grow. There are other immense tracts where it is too cold, where there is almost perpetual snow and ice; then there are other desert areas where there is plenty of sunshine and a suitable temperature, but insufficient rainfall, and then there are yet other areas, also very large in extent, where Nature seems to be too exuberant, where there is too much of everything, too much sunshine, too much heat and too much rainfall, areas which are now covered by the tropical rain forests. Great potentialities for food production could be created in some of the desert areas and in the tropical rain forest areas but, before these territories can produce very much, they require more or less intensive preparation and a great part of that preparatory work is of a kind which must be done by civil engineers. Developments at present inconceivable will doubtless have to be embarked upon. Much could be achieved, for example, if by some process sea-water could be made suitable for irrigation. Methods of inducing rainfall by charging the atmosphere with water vapour have also been suggested.

There are great difficulties in the way; there are economic, psychological, agricultural, medical and engineering problems, and in view of this some people consider that the right way to set about great schemes of land reclamation is for the initiative to be taken by Government under whose general economic guidance operates a team of scientific investigators and planners, followed by a team of engineers, farmers and others. The arguments in favour of such procedure appear to be very plausible, but if we are to judge from recent experience in parts of Africa, there may be something fallacious in the conception. You may reject as an over simplification the idea that anything undertaken by private enterprise stands a good chance of succeeding, whereas, everything controlled by politicians is foredoomed to failure. You may rather be inclined to take the view that the essential criterion for success is that the enterprise, whatever it is, should have the support and the guidance of men endowed with that strange quality, sometimes called genius or flair or vision. It is admittedly a rare quality and unpredictable.

Whatever be your judgment in this matter, you will, no doubt, agree that the immense undeveloped areas of land surface in temperate and tropical zones, both jungle and desert, at present unused or unusable, constitute a challenge to the engineer and that the rapidly increasing population of the world plus the demand for an improved standard of living in the backward areas, makes this challenge an urgent one.

While I am on this subject of food supply, there is this other problem of retaining soil fertility that I mentioned. The problem is how the engineers can make restitution for the injury they have, through their modern sanitation, inflicted upon the balance of fertility by depriving the soil of those waste products which ought to return to it. It is true that methods of sewage treatment and disposal have been devised and are in successful use in many places whereby the valuable waste products are not thrown away into the sea but are preserved and put back into the land. Unfortunately, such systems do not as yet seem to be generally acceptable. The problem is to make them so much more acceptable and, indeed, preferable, to the other unnatural and wasteful systems as to reverse the present one-way traffic whereby the human inhabitants are made to perpetrate the folly of taking everything they can out of the land while putting nothing back.

Consulting Engineers

Another modern problem that I should like to mention and which has suddenly

*Institution of Civil Engineers, April 24th, James Forrest Lecture. Extracts.

come upon us since the war, is relatively a small matter, in that it mainly affects in a professional sense the Members of this Institution. It relates to the prospects of British engineers who are seeking to be engaged on work overseas.

Our foreign competitor, assuming the dual role of consulting engineer and contractor, offers to do everything: to investigate everything, to design everything, to build and supply everything that the client needs, so as to produce an electric power station or a hydro-electric project, or whatever it is that the client wants. It is quite evident that the successful overseas adventure of British civil engineering contractors and engineers is a matter of importance to this country from the point of view of the export drive and if the British engineers are to hold their own in the present and future conditions, it may be that they will have to amend their methods of trading. Here is a problem which may in your opinion call for careful consideration.

Coal

Another of the great perennial problems, to which several of my predecessors referred and which confronts us to-day in a more injurious guise than ever before, concerns coal.

Lecturing in 1920, Sir Dugald Clerk came more directly into contact with the main problem when he spoke about the need for coal conservation in this island. Sir George Beilby, when delivering the lecture in the following year, that is 1921, spoke on the subject of "Fuel Problems of the Future." He expressed great alarm at the increased cost of coal brought about as a result of the rise in wages that took place during the 1914-18 war and doubted whether Britain could ever regain her position as purveyor of coal in world markets. He mentioned oil and alcohol as substitutes for coal.

The problem to-day is a little different because the National Coal Board has taken over the mining of coal and proposes to spend a great deal of money in sinking new pits and in mechanising the industry, but no matter what the Coal Board is able to accomplish by way of improvements in underground conditions and working, it must find it difficult to reverse the present trend of sentiment which is definitely against working underground.

Various remedies have been suggested, such, for example, as burning the coal in the seams underground in the way that the Russians are reputed to be doing. Other remedies involve abandoning coal and switching over to some other source of power, such as atomic power or to oil. There has, of course, already been a big switch over to oil, but it is not really a satisfactory solution because nearly all our oil has to be imported a long distance by sea from foreign countries and also because the world's oil supply may not last much longer perhaps than fifty years, whereas there is coal in this country to last hundreds of years and in the world as a whole to last thousands of years.

The Government, at their wits end in wartime, resorted to the expedient of open-cast mining, which in this country usually means turning over vast quantities of clay and rock overburden in order to scratch up a pittance of poor quality coal from a partly worked or faulted seam beneath. The coal so obtained is costly and the good land above, even though it be resoiled, is sometimes spoiled.

A great and obvious palliative for coal scarcity is to make the best use of the coal that is available and much effort is now being directed towards the avoidance of waste. It may in this connection be permissible to mention a rather large and continuous waste of heat for which engineers are themselves responsible and which they have not so far been able to avoid, that is the waste of the surplus heat generated in steam and oil power stations and in all sorts of other industrial process plants. The present custom is to get rid of this surplus heat through the intermediary of cooling water pumped from the sea or from a large river or canal and afterwards allowing the warmed-up water to run back into the source and cool down. This requires a large body of cold water in which to dissipate the heat. The alternative where no such large body is available is to use the cooling water many times over, the heat absorbed by the water each time it goes round the cooling circuit being dissipated by evaporation of a small fraction of the water in one of those lofty cooling towers which have become such a prominent feature of the industrial landscape.

Besides the waste of heat or waste of fuel, which is the primary problem under consideration, the whole system of heat dissipation by means of cooling water is full of objectionable features, among which may be mentioned, first, the constraint which the availability or non-availability of cooling water sources exercises in the choice of sites for power stations and factories; secondly, the great expense involved in constructing and operating the cooling water intake and outfall works, culverts, pipes, valves, cooling towers, pumps, interceptors and so forth.

Scientists and Engineers

By science is meant the particular brand of knowledge and way of thinking that has come into being as the result of the scientific revolution. There may have been some among the ancients who practised this way of thinking, but it was not adopted on a wide scale until modern times; indeed, the Scientific Revolution may be regarded as by far the most significant movement that has taken place in the world during the last 1000 years. It has been the work of Europeans, almost exclusively the work of the peoples of Western Europe. Copernicus did something to get it started when he published his work about the earth turning on its own axis, and Galileo did something to define it when he laid down the rule that scientists should confine themselves to things that could be measured and calculated. By the time that Newton published his "Principia" in 1787, the new way of thinking was going forward strongly. Now, it is rather a curious thing and one that has been frequently remarked upon, that good engineers are very seldom good scientists in the strict sense, although there is to-day a great dependence of engineers upon scientists, many engineers nowadays being reluctant to move a step without obtaining some kind of scientific test or report to back their judgment. You can say the same thing the other way round, that first-class scientists seldom make good engineers. The fact is that engineers are essentially craftsmen, and the engineering profession should be the great fosterer of the crafts.

Engineers' business is to provide water, to dispose of sewage and rubbish, to attend to heating and lighting, to erect buildings. They have to assist in all those processes whereby goods, including minerals and agricultural produce, are obtained and manufactured, and they have to make the apparatus whereby goods, messages and passengers can be transported by land, by water and by air. In the performance of these duties, innumerable crafts, such as carpentry and electric welding, are developed and flourish. The chief glory of engineering lies in the marshalling of craftsmanship—artistic craftsmanship and creative effort. The engineer's calling is old established. Sir Harold Hartley told us in his 1933 lecture that engineering had massive achievements to its credit at an epoch when his own branch of science chemistry was little more than a superstition. The engineer's calling, albeit humble, is highly respectable.

Scientists, on the other hand, operate upon a very high intellectual plane. The scientific method has not inaptly been described as a form of prayer. The first requisite for effective prayer is faith, and all true scientists have faith. They start off with an unshakable belief that underlying the phenomena in their field of investigation there lies a pattern. They are not always so sure that they can find the pattern, but they have no doubt whatever that the pattern exists, and they intend to try and find it. They have worked out a code of practice comprising close observation, careful recording and wholehearted concentration of effort, and by following the code with all its checks and controls they expect to discover the pattern and to formulate what they call the laws of Nature. You will observe here the second requisite of successful prayer, namely, concentration which may be carried by some scientific workers, and often is carried, to a degree of almost total absorption in their work.

It is by no means surprising that the practitioners in the Temple of Science, proceeding on the lines described, have achieved within the ambit of their worship results of the most spectacular kind. The paladins of science, mathematically armed, have in the past 200 years explored the totality of their sensory impressions which they regard as comprising the physical universe. To their domains they are adding year by year. There seems to be no end to their triumphant progress. So prodigious have the achievement of science been that the eyes of men are dazzled, their ears stunned, their wills paralysed and their minds hypnotised. The engineers have joined in a pæan of praise and adulation.

Confronting this problem of the correct relationship between engineering and science afresh to-night and with an open mind, it does, indeed, seem that the attitude of regarding the engineer simply as a person whose function and scope is to make practical applications of scientific discoveries is altogether too limited. This definition of his overlooks the engineer's primary function, which is the preservation and fostering of the constructional crafts, many of these crafts being themselves much older than science and their practice more conducive to the development of human character and happiness than any scientific pursuit. It also overlooks the engineer's function as an artist, another faculty which is very important and which has no relation to science. It, moreover, and most important of all, leaves out of account the duty of striving for a growth of sanity.

The suggestion which is being presented to-night is that we engineers as practitioners of an old and highly respectable craft should revert to our former attitude of standing more upon our own feet, possessing more our own minds, and that we should bestow upon the scientific element a more cautious and discriminating appraisement than hitherto.

It is rather remarkable to find that Professor William Anderson, F.R.S., M.I.C.E., when delivering the first James Forrest Lecture made a reference to researches which had shortly prior to the time he spoke been inaugurated by a group of people in this country. He drew attention to a class of phenomena which, to use his own words, "can be accounted for on the supposition that one mind can interact upon another." "Numerous," he said, "are the cases of presentiment or knowledge of events before they have taken place at a distance." He went on to say that "the poet frequently penetrates at random deeper and earlier into the mysteries of Nature than does the sober man of science." These were very significant and penetrating observations, referring as they did to a subject which few of the sober men of science are prepared to discuss. It is rather extraordinary, therefore, to find the first of the James Forrest lecturers referring to this tabooed subject so openly and also to find him appealing to Mr. James Forrest, who was, of course, present at the lecture, to bear him witness that no part of knowledge, even knowledge of this kind, lay without the compass of the engineer.

I would like to mention that the researches to which Professor Anderson referred in the first lecture, researches which Mr. W. E. Gladstone considered to be the most important of all researches, have continued in a very quiet way ever since, mainly in Britain and America, and that evidence has been steadily piling up. During recent years there has been a new method of approach whereby researches of a limited character have been conducted in the laboratory under strictly scientific control, and in the most rigid accord with the scientific code of practice, and to the recorded observations within this limited sphere have been applied mathematical computations regarding chances. The conclusions which derive from these researches indicate the existence of a kind of phenomena which do not at all fit into the accepted framework of physical science.

These new phenomena, though unaffected by the limitations of space and time, and though acting in apparent defiance of the accepted mechanical laws, are susceptible to human temperament, obedient to mental states, bound up very definitely with consciousness. It is possible that the extended study of such phenomena may not be capable of pursuit along the lines of the scientific code of practice and that the comprehension of the world in which these phenomena exist is not within the scope of human intelligence—that is, of the intellect as commonly understood and applied. It is possible that the comprehension of this new world may require a different method of approach, a different state of consciousness altogether, a *tertium organum*, to use the term which Ouspensky borrowed from Bacon.

It may also be that some people have already attained the approach to knowledge by intuition and that many people do so approach in rare flashes. It may quite possibly be that many or all works of genius and all genuine advances of the human mind, things like Einstein's mathematics, Parsons' turbines, Ford's mass production, Whittle's jet engines, Watson Watt's radar, Marconi's wireless, to mention a few modern examples, owe their origin rather to an intuitive perception of truth on the part of the founder than by intellectual reasoning.

Is it not a curious thing that unmistakable advances in arts, in thought and in craft are brought about so frequently not by properly equipped and properly instructed people, but by outsiders. Einstein was in his youth an employee in the Swiss Patent Office, Marconi spoke of himself as an amateur, the use of reinforced concrete was first demonstrated by a French gardener, Henry Ford was a garage man, the designer of the "Great Eastern" (a steamship fifty years ahead of her time) was Isambard Kingdom Brunel, a civil engineer with no training in naval architecture, and his assistant, Froude, also a civil engineer, was the man who established the empirical laws of ship propulsion. It is curious, too, that Colonel Crompton, who achieved so much for electrical development, started life as a naval cadet in the Crimean War, afterwards went into the Army and only acquired a kind of accidental interest in electricity and engineering. Bessemer, the inventor of the blast-furnace, attacked the problem as an outsider who broke away from the traditions of the steel trade. Parsons, the inventor of the steam turbine, broke right away from established lines of prior steam engine practice with which he could scarcely have been fully conversant.

In our present condition of abysmal ignorance about the things that matter, it is, of course, impossible to do more than present a problem. There are reasons to suppose therefore that the present critical phase of evolution which is now (as had just been described) painfully proceeding, will proceed more rapidly and effectively in a civilised and cultured human society than under barbaric conditions, and it is possible to suggest, therefore, that the engineer's function in providing the material conditions in which civilisation and culture can flourish is a worthy profession and a profession into which the engineer may boldly adventure and where he should in obedience to whatever inward perception of truth has been vouchsafed to him, confidently deploy whatever of creative power has been inborn in him, whatever of technical skill has been acquired by him, and whatever of artistic craftsmanship seeks to find expression through him.

British Industries Fair

No. V—(*Continued from page 662, May 18th*)

IN this issue we conclude our descriptive review of some of the exhibits shown at the British Industries Fair, which closed on Friday, May 11th.

Crompton Parkinson, Ltd.

An interesting exhibit was arranged by Crompton Parkinson, Ltd., Crompton House, Aldwych, London, W.C.2, to demonstrate some of the characteristics of a self-regulating alternator embodying a "Magnicon" exciter, which dispenses with the need for any form of automatic voltage regulator.

The "Magnicon"* is a rotating amplifier, which derives its excitation from armature reaction, the principle of operation being akin to that of the familar Metadyne and Amplidyne. Briefly, the "Magnicon" is a machine having four pole pieces, an opposite pair of which carry a control winding capable of setting up a small control flux. This control flux generates, in a short circuited armature winding, much larger currents, and the associated m.m.f magnetises the main field system, including the second pair of poles. Rotation of the armature in the flux produced in this main field system generates the output current. Amplification of the original field current can be considered, therefore, to take place in two stages: in the first stage the control flux set up by the control current generates heavier currents in the short-circuited armature; in the second stage the armature currents establish the main flux, which generates the output currents in the rotating armature. Unlike other rotating amplifiers, the "Magnicon" armature winding has "half-span" coils, whereby the main flux and control flux become mutually independent, without requiring any compensating device.

To apply the inherently high amplification to the control of alternator voltage the "Magnicon" exciter is fitted with two control windings—one of these windings carries a constant reference m.m.f., while the other carries a negative feedback m.m.f. proportional to the controlled quantity. The small resultant of these two m.m.f's provides sufficient excitation to keep the controlled quantity within the specified limits.

The principle of operation is portrayed, in its simplest terms, in Fig. 38, from which it clear that any particular terminal voltage of the alternator is associated with a definite value, *AB*, of resultant flux, which

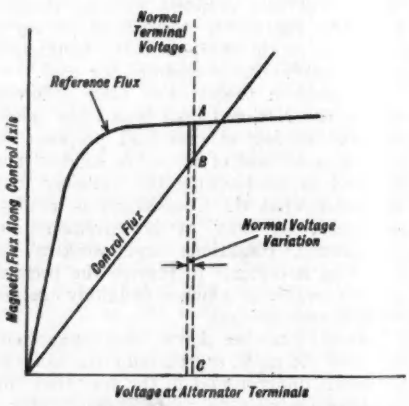


FIG. 38—PRINCIPLE OF CONTROL FLUX IN "MAGNICON" EXCITER—CROMPTON PARKINSON

is the difference between the reference flux, *AC* (saturated), and the control flux, *BC*. Because of the high amplification, a small variation in the alternator terminal voltage is quite sufficient to produce the necessary excitation to restore terminal voltage and to maintain it within narrow limits, over a wide range of speed, load and power factor. The initial setting, which determines the operating point, is made by a small hand regulator in the control circuit. After the regulator has been set the normal "Magnicon" exciter will maintain the terminal voltage within $\pm 2\frac{1}{2}$ per cent of the nominal value.

To demonstrate the self-regulating characteristics of alternators with "Magnicon" exciters, two such machines, each of 10kVA capacity and each driven by a d.c. motor, were connected to a control board. Demonstrations were given of the inherent self-regulation, of the ease of synchronising for parallel running at various loads and power

*"The Magnicon" by J. Griffin, *Electrical Times*, April 12 and 19, 1951.

factors, and of the rapid voltage recovery when switching full load on and off the machine.

Our illustration (Fig. 39) shows a 75kVA

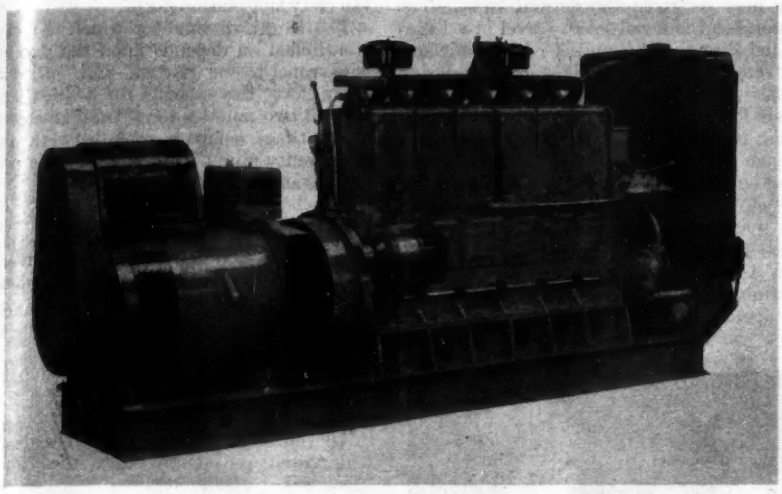


FIG. 39—ENGINE-DRIVEN "MAGNICON" ALTERNATOR—CROMPTON PARKINSON

"Magnicon" alternator flexibly coupled to a Russell Newbery 100 b.h.p., 1000 r.p.m. six-cylinder engine. In this arrangement the belt-driven "Magnicon" exciter is mounted on top of the alternator frame.

Another exhibit on the same stand was an example of the company's recently introduced "CLA" metalclad switchgear, which is a development of the "ALA" switchgear for ratings up to 11kV, 600A

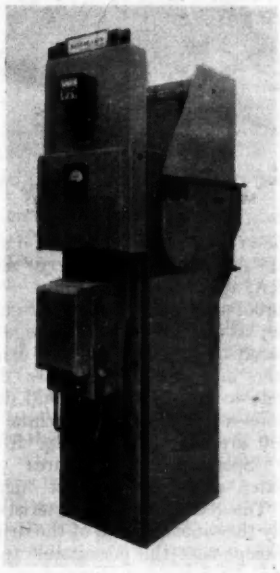


FIG. 40—"CLA" METALCLAD SWITCHGEAR—CROMPTON PARKINSON

normal current, and 250MVA breaking capacity. The new switchgear (Fig. 40) resembles the "ALA" switchgear but, instead of having air insulated busbar and current transformer chambers, the "CLA" equipment is designed with compound filled busbar chambers, the current transformer chamber being suitable for oil or compound filling, as required. The switchgear is vertically isolated, the oil circuit breaker truck being withdrawable after lowering. Raising and lowering is done by a heavy steel square thread jack screw, engaging with a bronze self-aligning nut, and operated by a brace handle. Three current transformers can be accommodated in the standard chamber but chambers can be provided for six or nine transformers, including precision units for metering.

KELVIN AND HUGHES, LTD.

Among the instruments shown by Kelvin and Hughes (Industrial), Ltd., 2, Caxton Street, London, S.W.1, was an electronic controller designed for controlling furnace temperatures or any variable capable of being indicated by a moving coil instrument.

The temperature, or other variable that is to be controlled, is detected by a suitable primary element, such as a thermocouple or resistance bulb, which causes a sensitive galvanometer pointer to move over a calibrated scale (Fig. 41). A light metal vane fixed to the indicator pointer can move freely between two coils, which can be set to correspond with any selected control point on the scale. The two coils form part of an oscillatory detector circuit, which is so designed that, when the metal vane

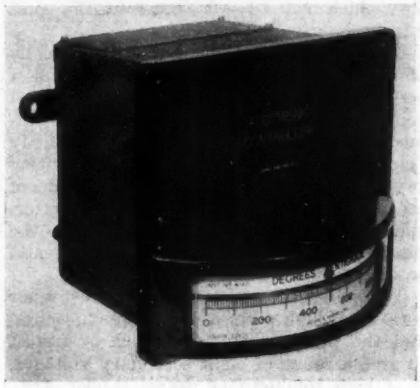


FIG. 41—ELECTRONIC CONTROLLER—KELVIN AND HUGHES

reaches a critical point between the two coils, oscillation ceases; the resulting current change actuates a relay, which can be connected to operate a regulating device. A slight movement of the indicating pointer about the control point is, therefore, enough to cause positive operation of the controlled apparatus.

For ease of servicing, the instrument consists of two replaceable units, housed in a dust-proof metal case. The lower compartment contains the indicating unit, comprising the 8½in scale, the control setting pointer and the detecting pointer, which is carried by the shock-proof, spring-controlled moving coil element and "Alcomax" magnet. In the upper compartment is the electronic assembly, which consists of a single valve oscillator mounted on a withdrawable chassis.

For operational safety the controller is designed to switch off the controlled plant in any of the following eventualities—power supply failure to the instrument, valve filament failure, low valve emission, or broken thermocouples.

The controller can be supplied to operate from 50 c/s to 60 c/s single-phase supplies of 110/125V or 220/250V and six standard temperature ranges, from 0–400 deg. Cent. up to 0–1400 deg. Cent., are available. The internal relay of the controller has a maximum capacity of 5A at 250V a.c., on a non-inductive load; for controlling larger currents in the external circuit a separate contactor is required. An elaboration of the simple two-positional control described above can be fitted, if desired, to give a limited proportional function. In its fume-and-moisture proof metal case the instrument measures 10½in by 9in by 10⅝in.

VARATIO-STRATELINE GEARS, LTD.

A large reduction gearbox was exhibited by Varatio-Strateline Gears, Ltd., of 278, Aberdeen Avenue, Trading Estate, Slough. This gear follows the normal principle of the "Strateline" range in that the input and output shafts are co-axial and the method of reduction consists of an outer stationary ring meshing with an

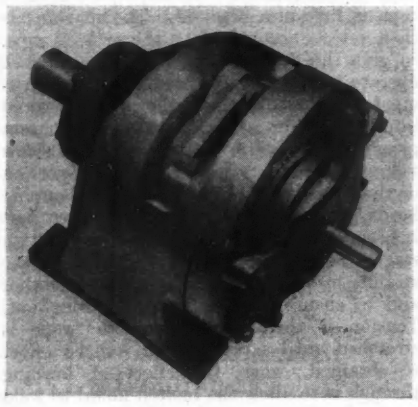


FIG. 42—REDUCTION GEAR UNIT—VARATIO-STRATELINE

eccentrically rotating pinion. The new gear utilises a modified form of coupling, consisting of hardened steel rollers operating within machined plates.

The gear is supplied for vertical or horizontal mounting either as an independent foot-mounted unit, as illustrated in Fig. 42, or with a motor integral with the unit.

The horsepower required to drive the gear is governed by the output speed and torque required. This power may vary from 2 h.p. for reduction up to 100 : 1, to 12 h.p. for a reduction of 20 : 1. The maximum output torque capacity for the single-stage unit is 16,000 lb/in, using a 750 r.p.m., 5 h.p. drive.

The gear can be supplied as a double-stage unit which produces torques varying from 18,000 lb/in to 30,000 lb/in. This

unit is usually fitted with a 1 h.p. motor and a 1500 r.p.m. motor can often be used.

In addition, this company showed a comprehensive range of "Strateline" speed reducers, giving a reduction of from 3 : 1 to 10,000 : 1, and also of its "Varatio" positive variable speed gearboxes. With these units any one of thirteen speeds can be obtained by moving a lever, whilst the box is in motion and under load. The horsepower capacity of "Varatio" boxes is from ½ up to 25.

An interesting working exhibit, consisted of a motor, a "Varatio" gearbox and a "Strateline" gearbox with a plastic case, all coupled to a tachometer. Visitors to the Fair were able to operate the "Varatio" box and see on the tachometer the variations of speed which could be obtained.

British Insulated Callender's Cables, Ltd.

A scale model of an electrically operated machine for parting wire ropes was one of the interesting exhibits seen on the stand of British Insulated Callender's Cables, Ltd., 21, Bloomsbury Street, London, W.C.1. The machine, which is claimed to be the first of its kind to be available commercially, is illustrated in Fig. 43. It operates by the combined effect of heat generated in the wire through the passage of electric current and of twist and tension applied externally to the heated wire. An inherent advantage of this parting operation is that the rope ends are left sealed and slightly tapered.

The machine is suitable for steel and hemp cored ropes ranging from ⅜in diameter to ¾in diameter, but for occasional use it can handle ropes up to 1¼in diameter. The parting operation, which is simple and fast, is briefly as follows. The required length of rope is first measured off. The machine is then set to accommodate the size of rope, to give the desired length of taper, and to operate at the correct speed. These adjustments having been made, the rope is lowered into the machine and clamped in the contact grips provided. A heavy current at low voltage is then passed through a portion of the wire rope held between the clamping heads, thus heating it to such a degree that it becomes malleable. In the initial heating stage, the rope is twisted to bring all the strands into close contact with one another and to ensure uniform heating throughout. Tension is then applied and the rope is stretched until a pronounced waisted effect is obtained, when the effect of burning through is to allow the molten metal to weld the ends of the strands and wires securely together, forming a neat seal which prevents strands unlaying.

The machine (Fig. 43) measures 2ft 9in by 4ft 8in by 4ft 2in high, and is mounted on four wheels to enable it to be readily moved to any site where a mains supply is available.

The clamping heads are of cast copper alloy, of ample dimensions to ensure mechanical strength. They take the form of slotted three-jaw chucks. This slotted clamping device allows the rope to be laid in the machine, so avoiding a long reeling-through operation. Two of the jaws on each head can be pre-set to accommodate the particular size of rope to be parted and are fitted with indicating scales. The third jaw is clamped hard on to the rope by means of a special box spanner provided with the machine. The bearing surfaces are machined and are of generous proportions, to reduce electrical resistance. The chuck jaws are of hard high conductivity copper alloy to give the maximum wear compatible with good electrical conductivity. They are renewable and easily accessible.

The torsion head can be rotated about its axis by means of a handwheel so that the rope may be given the desired twist. The tension head is arranged to travel in a longitudinal direction by means of a handwheel and screwed spindle. This spindle is slotted along its length and forms part of a trough which leads to the centre of the clamping heads, in which the rope is laid. To avoid damage to the rope during handling the outer ends of the trough are bell mouthed. The gap between the heads varies from 1½in to a maximum of 7½in—as indicated on the scale—the maximum working range being from 1½in to 5½in. The initial setting is determined by the size of rope and length of taper required. Guards are fitted to

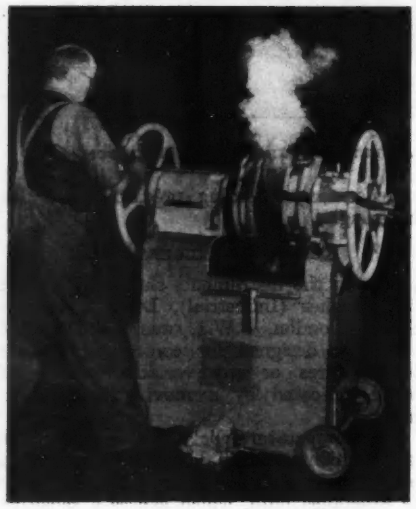


FIG. 43—WIRE ROPE PARTING MACHINE—B.I. CALLENDER'S

prevent the ingress of flash or oil to the transformer compartment in the body of the machine, and the side and end plates are easily removable for inspection of the electrical equipment. A removable tray is laid under the clamping heads to catch any oil, &c., which may be expressed from the cores during the parting operation.

The electrical equipment consists basically of a transformer of 25kVA rating, and a contactor actuated from a pedal-operated control switch. This equipment is accommodated in a rigid cast iron and steel body below the clamping heads. An isolating switch is mounted on the left-hand side of the body, within easy reach of the operator, and provision is made for connecting to the supply mains through a three-pin plug and socket.

The magnetic circuit of the transformer consists of high permeability iron stampings, and the primary winding, which is tapped to give a range of eight secondary voltages, is of high conductivity drawn copper strip, cotton insulated, impregnated and baked. The primary tappings are led to a plug box having six sockets and mounted on the right-hand side of the body, the sockets being marked "Fast," "Slow," "1," "2," "3" and "4." Two plugs are provided, one of which is for insertion in the "Fast" or "Slow" socket, and the other in one of the numbered sockets. When the plugs are inserted in "Fast" and "1" the highest secondary voltage is obtained, whilst the lowest secondary voltage is obtained when the plugs are in "Slow" and "4." Micanite insulation is provided between the primary coil and the iron core. The ends of the secondary winding (which is of laminated copper strip) are attached to the clamping heads, the torsion head being insulated from the body and tension head.

The length of time for which the current is switched on depends upon the size of the wire rope to be parted, and varies from about forty-five seconds for a ⅜in diameter rope to two minutes for a 1in diameter rope. These times compare with between twelve and twenty minutes required for the parting process at present in general use.

Brook Motors, Ltd.

Examples from a new range of drip-proof and splash-proof motors, designed to be competitive with American motors in overseas markets, were among the machines shown by Brook Motors, Ltd., Huddersfield. The complete "Brema" range, as it is called, covers outputs from 0·5 to 40 b.h.p. at synchronous speeds ranging from 720 to 3600 r.p.m.

All the motors in the range are designed and tested to comply with the National Electrical Manufacturers' Association Standard (N.E.M.A.) for frame sizes and dimensions, horsepower ratings, service factors, temperature rises and performance. The motors are also stated to comply fully

FIG. 44—DRIP-PROOF SQUIRREL CAGE MOTOR—BROOK MOTORS

with the requirements of the Canadian Standards Association and carry the relevant C.S.A. approval No. 10,159.

Drip-proof and splash-proof enclosures are available; a drip-proof squirrel-cage motor is illustrated in Fig. 44. In this drip-proof design the end shield vents are directed downwards to stop entry of liquid drops or solid particles falling on the machine at any angle not greater than 15 deg. from the vertical. Splash-proof enclosures provide still greater protection against ingress of liquid. The electrical characteristics are essentially the same as those of the drip-proof motor, except that the permissible temperature rise is 50 deg. Cent. instead of 40 deg. Cent.

Both kinds of machine incorporate stator frames and end bells of cast iron, ribbed internally for strength. Class "A" insulation, including micanite, is used for all stator slots, the windings being former wound with synthetic-resin-covered wire. The whole winding is fully impregnated, dipped, baked and sealed with additional coats of insulating paint.

The rotors are dynamically balanced and end play is compensated by an anti-bump washer. The rotor shaft at each end runs in ball-bearings which are of the same metric size, to make the end shields interchangeable. A rotating bearing cap between the rotor and

each bearing prevents grease from reaching the windings and the inside of the motor.

The machines are suitable for a.c. voltages of 100, 208, 220, 440 and 450 at 60 c/s and 50 c/s. They are designed to operate satisfactorily with a voltage variation of 10 per cent provided that the frequency variation does not exceed 5 per cent. A continuous overload capacity of 15 per cent is specified, the momentary overload capacity being 50 per cent above rated full load.

Londex, Ltd.

An extensive range of relays and process timers was shown by Londex, Ltd., 207, Anerley Road, London, S.E.20. The exhibits included a process timer, for energy regulation, which has been applied to the control of electric furnaces and industrial hot plates.

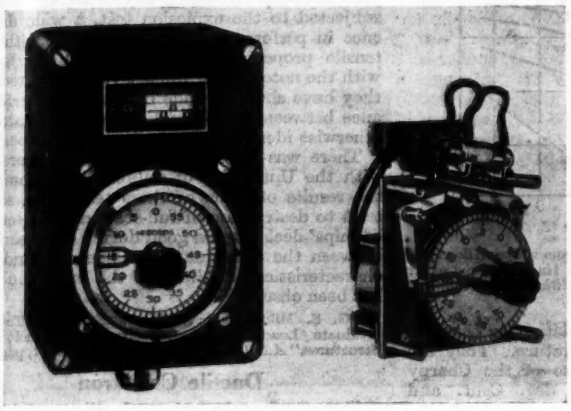


Fig. 45—Process Timer—Londex

In this instrument (Fig. 45), the dial and pointer are driven continuously as one unit by a synchronous motor. The rotation causes cyclic closure and opening of a heavy-duty mercury switch which, as shown in the right-hand view, is actuated by a cam and cranked followers. The total time of the operating cycle is determined by the gearing and dial fitted, while the "on" period depends on the setting of the pointer. For example, if the pointer of an instrument incorporating a one-minute dial is set to ten seconds the external circuit will be closed for ten seconds in every minute and will be open for the remaining fifty seconds. A choice of seven time cycles is available, as follows:—one, six, fifteen, sixty minutes, and six, twelve, twenty-four hours. In each instance the knob in the middle of the dial allows the pointer to be set to give any "on-off" ratio between 0 and 100 per cent.

The mercury switch is rated at 10A and up to 500V, a.c. It is a submerged-electrode switch producing a mercury-to-mercury make and break, and it has a porcelain anti-track lining. The standard motor driving the timer operates on 200V to 250V, single-phase, 50 c/s supplies, and has an input of 2VA.

Blaw Knox, Ltd.

A recent addition to the wide range of constructional equipment made by Blaw Knox, Ltd., of Clifton House, Euston Road, London, N.W.1, is a new circular clamshell-gate concrete bucket which was shown on the firm's outdoor stand at Castle Bromwich. This kind of bucket is particularly intended for use when placing large masses of concrete in major construction schemes. It is made in 2, 3, 4 and 8 cubic yard capacities, the one shown being of 4 cubic yards. The bucket is largely of fabricated tube and plate construction and its discharge gates are operated by compressed air. Weighing nearly 2 tons, the bucket is over 6ft diameter and nearly 14ft high.

Other exhibits included the firm's ¼ cubic yard excavator, concrete mixers, concrete pumps and an improved design of the "Junior" weigh batcher, with three compartments instead of two, as hitherto. Also shown on the stand was a half-scale model of a transmission tower showing the design of towers supplied to a number of authorities at home and abroad. This half-scale model was 43ft high.

The Donovan Electrical Company, Ltd.

Among the new products shown by the Donovan Electrical Company, Ltd., 70–82, Granville Street, Birmingham, 1, was a direct switching contactor starter (type "A30," size 0), suitable for all a.c. self-starting motors up to 3 h.p., 550V.

Our illustration (Fig. 46) shows the starter in its dustproof case, with the cover removed to show the mechanism. The starter is magnetically operated and is fitted with an under-voltage release and three hand-resetting overload trips. There are two breaks per pole, the contacts being silver and liberally rated for the specified maximum horsepower.

Fig. 46—Direct Switching Contactor Starter—Donovan

The starter is suitable for direct control from the "start" and "stop" push buttons mounted in the front cover; alternatively, it can be controlled from a remote push-button station or from any two-wire control device such as a float switch or a limit switch; finally, it can be controlled by a special switch in the cover, to give try-out operation with any two-wire device. When the contactor is tripped the magnet drops out by gravity so that switch opening does not depend on springs.

Electromagnets, Ltd.

A new magnetic feeder unit, designed to provide greatly improved magnetic separation, was among the exhibits shown by Electromagnets, Ltd., Bond Street, Birmingham, 19.

As illustrated in Fig. 47, the equipment takes the form of a short-band conveyor. Instead of the usual magnetic pulley at the terminal head on the left of the conveyor, the belt is contoured accurately round a stationary magnetic head, by means of a number of non-magnetic rollers. The magnetic head, in its sheet brass casing, is not subject to dimensional limitations, which restrict the size of a magnetic pulley. Accordingly, in the new design there is room for long deep coils which are stated to be capable of providing three or four times the magnetic intensity associated with a magnetic pulley of comparable diameter. Furthermore, the magnetic flux is usefully concentrated over the curved portion of the conveyor path, whereas in the orthodox design the flux is distributed more or less uniformly over the pulley circumference, only half of which can be used to collect tramp metal.

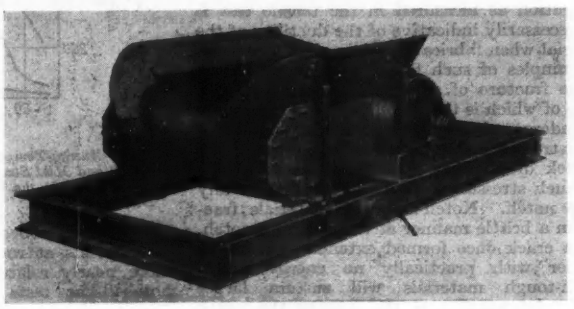


Fig. 47—Magnetic Feeder Unit—Electromagnets

The driving pulley is carried on a shaft which runs in self-aligning plummer block bearings and is roller-chain driven by a totally enclosed geared motor unit. There is provision for altering the conveyor belt tension by adjusting screws which bear on the foot of each plummer block.

The G.E.C. Research Laboratories

The General Electric Company, Ltd., has announced the appointment of Mr. O. W. Humphreys, F.Inst.P., M.I.E.E., as director of its research laboratories. Mr. Humphreys has been manager of the laboratories for the past two years, a position to which he succeeded following the death of Sir Clifford Paterson. During that period, the G.E.C. has continued to expand its research activities, and has opened additional laboratories in the neighbourhood of the main laboratories at Wembley, and also at Stanmore. The total staff now engaged in research work numbers more than 2000. Mr. Humphreys is a Fellow of the Institute of Physics and a member of the Institution of Electrical Engineers. He is also a member of the councils of the British Electrical and Allied Industries Research Association and the British Non-Ferrous Metals Research Association, and has recently been elected a manager of the Royal Institution of Great Britain. In addition, Mr. Humphreys serves on a number of committees of the British Standards Institution and was a member of the Board of Trade committee of inquiry into the organisation and constitution of the B.S.I., which presented its report last year.

Metallurgical Topics

Explosion Tests on Structural Steels

An estimate of the load-carrying capacity of a structure is usually based entirely on two factors: an elastic stress analysis and the yield strength of the material as determined in the standard tensile test. Ductility, though it does not enter into the stress calculation, is regarded as an important and desirable property of structural materials; so that, other things being equal, the material with the higher ductility is usually favoured by designers. Certain critical points of stress concentration exist in most structures at some time during their life, and the load-carrying capacity of a structure is affected by its capacity to undergo plastic deformation at such points without fracture. In many cases failure is to be attributed to poor ductility of the structural materials under certain conditions of stress. Elongation as measured in the tensile test is not necessarily indicative of the ductility of the material when fabricated into a rigid structure.

Examples of such failures are found in the brittle fracture of ships' plates, the apparent cause of which is the inability of the steel plate to undergo plastic deformation at points of high stress concentration, an inability caused by lack of ductility under multi-axial stress, i.e., such stresses as occur at the root of any sharp notch. Notch-sensitive materials fracture in a brittle manner at the root of a notch, and a crack once formed extends in a brittle manner with practically no energy input. Notch-tough materials will sustain larger plastic deformation at the root of the notch before fracture begins, and propagation of the fracture will require a large amount of additional energy. These characteristics are measured in the notched-bar impact test, but it was felt that a test was required to evaluate susceptibility to brittle fracture without the use of notches or other geometrical stress-raisers, which, in effect, produce the desired state in a comparatively small and predetermined part of the specimen. An intensive investigation was undertaken under the sponsorship of the Bureau of Ships of the U.S. Navy Department to determine the applicability of a direct explosion test to the evaluation of the load-carrying capacity of structures. Some of the results were recently described by G. S. Mikhalopov.[1]

Tests on Low-Alloy and Mild Steel Plates

Ballistic tests, as applied to armour, were regarded as too drastic. A charge of explosive was detonated in contact with the plate. The explosive used was essentially a mixture of TNT, sodium nitrate, ammonium nitrate and aluminium powder, packed to the desired density in cylindrical paperboard containers. The energy of the explosion was first measured by means of ballistic pendulum tests; and it was shown that the energy communicated to the surface at which the explosive detonated was proportional to the mass of the explosive up to a certain limit, beyond which the effectiveness of additional mass decreased rapidly. Within this limit, the energy could be expressed in terms of the mass of the explosive.

The tests were carried out on 1in or 1½in plates, 18in square, or on ½in plates, 12in square. The 1in plates (which were of the thickness most commonly used) were supported all round on a rectangular base, 4in high and 2½in wide, laid loosely to form a 16in hollow square. The explosive charge in a 4in diameter container (or 3in for ½in plates) was exploded in contact with the upper face. Five specimens have to be so treated to obtain the maximum deformation, or the absorption of energy to fracture. The charge just sufficient to initiate fracture was obtained to within 10 g in a total charge of 500 g to 700 g. Brittle plates tended to shatter, the cracks going in all directions. In ductile plates the energy to fracture was taken as that required to produce a crack, 8in to 10in long, through the plate.

In Fig. 1 the curves *A*, *C* and *D* show the minimum energy (expressed in mass of explosive required) to fracture several structural steels tested by the direct explosion method. The corresponding mechanical tests are given in Table I. It is clear that the results of the

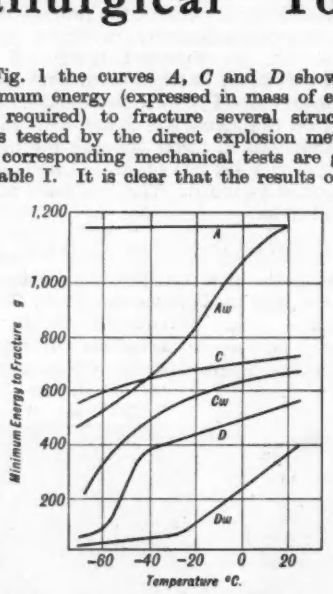


Fig. 1—*Energy-Temperature Diagram of Low-Alloy Steel (A, C) and Mild Steel (D) Plates, 1in Thick, and of the Same Steels in the Welded Condition (Aw, Cw and Dw)*

explosion tests bear little relation to those of tensile tests at room temperature. They are more nearly related to those of the Charpy notched-bar tests at −40 deg. Cent. and

Table I.—*Properties of Some of the Steels Tested (Mikhalopov)*

	Low-alloy steels		Mild steel
	A	C	D
Tensile tests at room temperature:			
Yield strength, tons per square inch	36	22	14
Tensile strength, tons per square inch	44·6	40·2	29·0
Elongation, per cent	26	30	32
Reduction of area, per cent	71	65	65
Charpy impact value at −40 deg. Cent. Keyhole notch, ft-lb	64	30	3
Minimum energy to fracture (Fig. 1)			
Grammes explosive at −40 deg. Cent.	1200	650	380
Grammes explosive at −60 deg. Cent.	1200	600	80

especially if the explosion tests made at a slightly lower temperature are selected for comparison.

Tests on Welded Plates

Static and notched-bar tests are not very suitable for testing non-homogenous material like welded joints; but by explosion tests a direct measurement of the effect of a welded part on notch sensitivity can be obtained. In Fig. 1 the curves *Aw*, *Cw* and *Dw* show the performance of the same steels as were tested in plate form, when fabricated by welding with procedures and electrodes designed to give a 100 per cent efficient joint as determined by tensile tests. The difference from the parent plate is greatest at low temperatures, but is quite pronounced at room temperature for the mild steel (*D*). The fractures were not confined to the welds though they usually originated there. The applicability of the direct explosion test rests on the assumption that its effectiveness is due to the induced multi-axial stresses rather than to the rate of strain. If high rates of strain were responsible, no difference in performance would be expected whether the welded portion were immediately under the explosive charge or at an adjacent position. Accordingly, some plates were prepared with circular welds. When the explosive was offset from the centre of the circle, so as to cover part of the weld, the characteristics of the failure reproduced those of the standard welded plates; but when the explosive was placed in the centre of the circle, the maximum strain in the weld was considerably greater, and fracture occurred at substantially the same energy input, and with approximately the same deformation, as in the standard specimens of the parent plates.

Conclusions

Tests on the lines indicated above have been in progress for eight years, during which a number of different types and grades of steel plate, usually 1in thick, have exhibited, when subjected to the explosion test, a wide difference in performance, not correlating with the tensile properties, but in general correlating with the notched-bar impact value. Moreover, they have shown a wide difference in performance between welded and non-welded plates of otherwise identical composition and properties.

There was an opportunity, in collaboration with the University of California, to compare the results of some of these tests with static tests to destruction of full-scale model sections of ships' decks, and a good degree of agreement between the behaviour of the models and the characteristics of failure in the explosion test has been observed.

[1] G. S. Mikhalopov: "Direct Explosion Test to Evaluate Load-Carrying Capacity of Welded Steel Structures," *A.S.T.M. Bulletin*, February, 1951, page 53.

Ductile Cast Iron

The product known as ductile, nodular or spheroidal-graphite, cast iron, which has now been available for some years, has been the subject of a very large number of papers reviewing its development, discussing the practical problems and economic aspects of its production, and describing the properties of commercially produced castings. Many of these papers record the experience of British, American and Continental foundries in the production castings by the alternative processes of magnesium treatment and cerium treatment now in use. The graphite of the magnesium-treated cast iron is generally referred to as spheroidal, and that of the cerium-treated cast iron as nodular, and many somewhat unconvincing attempts have been made to justify this distinction on scientific grounds; but, as applied to the structure of the graphite, the terms are synonymous. There may be differences of opinion as to the best method to use, but the products of the two processes are structurally and mechanically similar. A short article summarising the properties of ductile cast iron appeared in The Engineer, December 30, 1949. Since that date a bibliography and a classified index of publications dealing with the subject have been published;[1] but perhaps the most informative series of abstracts of some of these publications is to be found in *The Nickel Bulletin* for the past few years. In this brief note attention is confined to the user aspects of the subject, i.e., the properties and applications of nodular-graphite cast iron.

Tensile Properties

Tensile testing of ductile cast iron should be carried out by the methods used for cast steel. Experience in a British foundry[2] has shown that under controlled conditions conformity with the following minimum specification can be consistently relied upon under commercial conditions:—

	As cast	Annealed
Tensile strength, tons per square inch	35	30
Elongation, per cent	—	10

The average in another foundry[3] was:—

	As cast	Annealed
Tensile strength, tons per square inch	38–42	30–33
Elongation, per cent	—	15–20
Brinell hardness number	280	180

but values as high as 50 tons per square inch were reached and in the annealed material an

elongation of 25 per cent was sometimes obtained. Castings to be supplied in the "as-cast" condition are best given a tempering or stress-relieving treatment at 500 deg. Cent. When maximum ductility is required castings are heated at 850 deg. Cent. for one to three hours, depending on the section, and are then slowly cooled over a period of two to three hours to a temperature just below Ar, and held there for five to eight hours according to the type of casting being treated. The elongation of the cast material of a 1¼in keel block test bar (tensile strength 40 tons per square inch) is raised from 2 to 9 per cent by tempering and to 17 per cent by annealing.

The actual properties of a casting are, of course, dependent on its size, and there is a progressive lowering of properties with increase of section. A good example of the effect of mass is given in Table I.

TABLE I.—*Tensile Properties of Nodular-Graphite Cast Iron in Different Sizes (F. H. Allison)*[*]

Section size	Tensile strength, tons/in²	Elongat'n, per cent on 2in	Reduction of area, per cent
As cast :			
1¼in keel block :			
Test bar	45·5	1·6	1·2
4in round	40·7	0·8	0·4
8in round	33·0	0·7	0·6
16in round	27·3	0·0	0·0
Annealed :			
1¼in keel block :			
Test bar	33·2	20·0	16·9
4in round	31·8	17·9	15·1
8in round	31·0	17·3	10·3
16in round	26·0	7·4	1·6

[*] United Engineering and Foundry Company, U.S.A., *The Nickel Bulletin*, July, 1950, page 131.

Compression Tests

The compressive strength of ductile cast iron varies directly as the hardness. The yield point in compression ranges from 25·5 tons per square inch with a Brinell hardness of 219 to 42·5 tons per square inch with a hardness of 321. The ratio of compressive strength to Brinell hardness number is of the same order whether the irons are of the nodular or of the flake-graphite type. Whereas in tests on pipes the bursting strength of the nodular-graphite cast iron was two or three times that of the flake-graphite type, collapse tests showed little difference between the two materials, the loads being in both cases nearly proportional to the hardness.

Elasticity and Fatigue

The stress-strain diagram of ordinary grey cast iron shows curvature from the start, and its "modulus" is not an elastic constant, but rather a measure of deformation over a given range of stress. The value of the "modulus" depends on the shape and distribution of the graphite flakes. Nodular-graphite cast iron, on the other hand, approximates much more nearly to steel in its behaviour and gives a proportional line indicating a Young's modulus of 25 or 26×10^6 lb per square inch. The damping capacity also approaches more nearly to steel than to cast iron, the decrement value for flake-graphite iron being 20 to 30×10^{-4}, while that of nodular-graphite iron is 5×10^{-4}. The ratio of endurance limit to tensile strength is similar to that of steel, viz., 0·44 for the iron as cast and 0·46 after annealing. Other tests, made on specimens cut from larger castings, gave lower values of the ratio (0·33 to 0·35) both for iron and for steel castings. The influence of a notch was less marked in nodular-graphite iron than in steel, and in a comparison of cast steel, acicular cast iron and nodular-graphite cast iron of similar tensile strength (31·7 to 33 tons per square inch) the notched ductile iron actually had the highest endurance limit among the specimens.

Impact Value

The impact value of the ductile cast iron in the "as-cast" condition is 50ft-lb to 90ft-lb (as measured in the modified Izod test for cast iron—B.S. 1349), whilst the annealed material may give a value of over 120ft-lb. The impact value of ferrite is rapidly reduced by falling temperature; and, owing to the fact that ductile irons consist essentially of a ferrite solid solution and graphite, the impact value of the material at −100 deg. Cent. is only about one-tenth of the value at room temperature, while there is a rise in tensile strength of about 14 per cent.

Growth

Prolonged heating below the critical range (550 hours at 550 deg. Cent.) caused slight growth in ordinary grey iron and rather less in ductile cast iron. Heating in air to 900 deg. Cent., holding at that temperature for thirty minutes and then cooling, repeated twenty-seven times, caused extensive growth and embrittlement in ordinary grey cast iron, but had a relatively small effect on ductile cast iron. Heating to 870 deg. Cent., holding for one and a half hours and cooling in air, repeated 100 times, showed clear superiority of nodular-graphite cast iron over grey cast iron in this respect. After an initial small amount of growth the iron becomes relatively stable. This cyclic treatment was very detrimental to the mechanical properties of grey cast iron, reducing its tensile strength by 50 to 80 per cent, but the same treatment increased the tensile strength of annealed nodular-graphite cast iron by about 2 tons per square inch, while lowering the elongation from about 7 per cent to 2·5 per cent or less.

Machinability

Machinability of the ductile cast irons is reported to be definitely superior to that of grey iron of similar hardness. In the "as-cast" condition ductile irons of optimum composition have the same machinability as low-strength grey cast iron, and in the annealed condition the machinability of the ductile material is far superior. The quality of the machined surface of ductile cast iron, also, is better than that of grey cast iron and closely resembles that of steel.

Applications

Nodular-graphite cast iron may be regarded, in the "as-cast" condition, as a further development of high-duty grey cast iron; whilst, in the annealed condition, it comes within the category of high-grade malleable, and is competitive with mild steel castings. An impressive variety of nodular-graphite iron castings is now being turned out, many of them on a mass-production basis; so that it may now be stated that the material is already commercially available on a scale of practical interest to designers and engineers. Illustrations of many of these castings have appeared in recent papers,[2, 3] and in *The Nickel Bulletin* for July, 1950, there is a good collection of photographs of typical castings, ranging from a 5-ton flywheel to brackets and levers of a few pounds weight, and including power plant, agricultural machinery and brackets and levers used in automobile industry and transport.

References

[1] F. R. Morral: *American Foundryman*, July, 1950, page 61, and January, 1951, page 43.
[2] N. Croft: *Iron and Steel*, February, 1951, page 45.
[3] M. M. Hallett: *Foundry Trade Journal*, January 4, 1951, page 3.

Shot Peening of Spring Steel

It has been recognised for some years that shot peening of springs is of advantage in raising their fatigue limit, but fresh demonstrations of the fact are frequently forthcoming. For example, N. B. Brown[1] has shown that a 0·8 per cent carbon steel, both in the normalised and in the water-quenched and tempered condition, has its fatigue limit raised by about 2½ tons per square inch by shot peening. When the tests were carried out in water, the fatigue limit of the shot-peened steel was not reduced as much as that of the unpeened steel, and the improvement effected by shot peening was therefore more evident. Some actual values are given in Table I.

Tests carried out on steel specimens which had been heated at 232 deg. Cent. after shot peening were stated to show that "the endurance life and fatigue properties of specimens given a stress relief heat-treatment after shot peening were superior to those given a smooth machine finish or shot peened." This conclusion, with specific mention of a "stress relief" treatment, is by no means firmly established. It would not be expected that the elimination of the residual compression stresses, which cause improvement in fatigue properties, would lead to a further rise in the fatigue limit, but rather the opposite. In any case, a temperature of 230 deg. Cent. is not high enough to give substantial stress relief, although it is quite high enough to restore the elastic properties, and render the material elastic to stresses higher than those which it would originally withstand. This may, perhaps, explain the endurance for 10^6 cycles of a higher stress (especially in the underwater tests) by the steels low-temperature treated after shot peening, though they showed no advantage over the shot-peened steel in fatigue limit based on 10^7 cycles.

TABLE I—*Tensile and Fatigue Properties of 0·8 per cent Carbon Steel (N. B. Brown)*

	Normalised 788 deg. Cent.		Water quenched 788 deg. Cent. Tempered 45 min at 645 deg. Cent.
0·2 per cent yield strength, tons per square inch	26·5		41·1
Tensile strength, tons per square inch	57·0		57·6
Elongation, per cent on 2in	12·5		20·5
Reduction of area, per cent	15·0		51·5
Charpy impact value, feet-pounds	7		12
Brinell hardness number	241		255
Estimated fatigue limit for 10^7 cycles in air :			
Unpeened	21·7		27·2
Shot peened	22·8		28·3
Shot peened and "stress relieved" at 232 deg. Cent.	24·1		29·7
Estimated endurance limit in water :			
Number of cycles ...	10^6	10^7	10^6
Unpeened	20·1	10·7	25·2
Shot peened	22·3	20·5	27·2
Shot peened and "stress relieved" at 232 deg. Cent.	30·1	20·5	28·3

There would appear to be an advantage in low-temperature treatment at a temperature not exceeding 250 deg. Cent. after shot peening, in increasing endurance at loads which would ultimately cause failure, without, however, raising the limiting fatigue strength; but it may be questioned whether the advantage of this treatment is in any way connected with stress relief.

[1] N. B. Brown, "Trans." Canadian Inst. Min. and Met., 1951, Vol. 54, page 121; *Canadian Min. and Met. Bulletin*, March, 1951, page 191.

Nickel Steels

One of the latest publications issued by the Mond Nickel Company is a booklet entitled "Isothermal Transformation Diagrams for Nickel Steels," which not only contains accurate and clearly drawn time-temperature-transformation curves for more than a dozen standard nickel, nickel-chromium, nickel-molybdenum and nickel-chromium-molybdenum steels but, in a twenty-five page introduction, explains in detail the method of determination and general features of the diagrams, and indicates the effect of composition and of time and temperature of transformation on the structure and properties of the isothermally transformed product. This section is well illustrated by photo-micrographs. Whilst the limitations of isothermal transformation diagrams are recognised and their use to interpret the course of transformation under conditions of continuous cooling is approached with caution, the special heat-treatments based on these diagrams (isothermal annealing, austempering, martempering, time-quenching, &c.) are fully dealt with.

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ECONOMY IN ARMAMENTS PRODUCTION

GOVERNMENTS, once having decided upon a policy, tend usually to be in a hurry to set it going. But in the production of armaments, upon which this country is to spend £4700 million over three years, the old adage of "more haste, less speed" holds good. No doubt the armed forces have a clear enough perception of what are those items of equipment that they want to see produced. But before definite orders are given to productive firms it is desirable to consider carefully and technically how best and most cheaply and with the least disturbance to the routine of factories those armaments are to be manufactured. For the fewer the man-hours of labour that need to be devoted to any armament items or to the making of machine tools, gauges, jigs, tools, &c., needed for armaments production the more the country will get in return for its expenditure over the next three years; the greater, too, will be the proportion of man-hours that can continue to be spared for the making of things which are fundamentally more important to civil life than are armaments, in that they raise standards of living instead of being designed, as armaments are, to lower them!

In an article in last week's issue Dr. Galloway, Director of the Production Engineering Research Association of Great Britain, had some very wise things to say about armaments production. "Only by developing basic production techniques in advance of the needs of the armaments factories," he wrote, "is it possible to avoid the costly process of developing techniques by protracted trial and error on the production site, a process which not only gives rise to considerable waste of time, labour and materials, but which frequently fails to develop the best techniques." Experience, twice this century, has emphasised the lesson that large stocks of armaments suffice only to fight short wars. For the development of design is so immensely stimulated by war that devices regarded as up to date at a war's beginning have become obsolete long before its end, whilst the rate of wastage is so high in war that the original stocks are very soon run down. Ideally, therefore, a nation setting out to fight a successful war should have available at its beginning little more armament than is sufficient to sustain the first shock. Thereafter the power to produce in quantity guns, tanks, aircraft, ships, shells, rockets, radar equipment and the multitude of other improved devices, more modern in design than the "stock" articles with which the war was begun, counts for far more than the weight of equipment originally available. But if that productive power is to be mobilised rapidly and if the transition of industry from peacetime to wartime production is to be conducted without confusion, war production needs to be better planned than it was in the last war. Continually during peace methods of production suited to war need to be worked out. As prototypes of new designs successively reach a stage at which full-scale production could, at need, be embarked upon, details not only as to the machine tools needed, but also about cutting speeds and feeds, &c., need to be calculated so that firms unaccustomed to the work shall have little need by methods of trial and error to work out production procedures as they go along. But for that process to be possible there must be available better knowledge than is available at present about basic production techniques applicable to various materials. As Dr. Galloway puts it, "In view of the relatively low cost and high speed with which basic production techniques can now be developed by well-established research methods, it is surprising that reserves of techniques have not been developed on a scale comparable with material and other reserves." He goes on to point out that the cost of "the establishment of improved machining and forming techniques and, alternately, of adequate standards of machinability and formability could be made with an expenditure of approximately £250,000," a sum "insignificant in comparison with the enormous sums of money now being expended on other forms of research which in themselves provoke more and more problems for the production engineer, and to which research on production techniques is complementary."

There is a further economy which might be made in preparing for armament production. It is one to which Dr. Galloway made no reference, though we have no doubt that he is aware of it. Sir Alfred Herbert referred to it in a recent issue of the "Machine Tool Review." In ordering tools for armament production, is sufficient thought given to the limited range of work the tool will be called upon to perform? That is a very practical point of particular importance at a time when many thousands of tools are to be bought abroad at heavy expense and when orders are going out to machine tool makers here. For machine tools are often ordered with equipment that is very unlikely ever to be used, so that they cost more than they need and time and materials are expended upon the manufacture of items that in fact will serve no purpose. "The most glaring instance," writes Sir Alfred, "is the fact that practically all centre lathes are specified as with sliding, surfacing and screw-cutting equipment." But how often nowadays is a lead screw used for screw-cutting? Again, to what extent is the chasing attachment of a capstan lathe required? Are not capstans sometimes specified when, in fact, for the work contemplated, the turret could be dispensed with? Do all the universal milling machines supplied really do work that could not be done at least as well on plain millers? And how much costly equipment, such as dividing heads, supplied as "standard" with a machine, is taken straight into the tool stores, never to emerge again until the machine is disposed of? Those are certainly cogent and very practical questions. A careful consideration of the answers that should be given them might lead to substantial economies in the cost of equipping works for armaments production.

PARIS I.C. ENGINE CONGRESS

NEVER previously has there been an international congress devoted solely to the internal combustion engine. Our friends in France are, therefore, to be congratulated not only on the extent and value of the papers communicated to the International Internal Combustion Engine Congress, held in Paris from May 7th to 19th, but also on the success with which an atmosphere of cordiality was spread over the entire meeting. There is, indeed, no atmosphere more conducive to the attainment of useful results, and its promotion in international gatherings is one of the needs of the times in which we live. Engineers, using a universal and unambiguous language, are apt to be good international "mixers" and Paris is a centre peculiarly well fitted as a venue for such meetings. For Paris is not only the city of Lavoisier, Pascal and Pasteur but of Papin, Cugnot and Carnot. Here it was, moreover, that Alphonse Beau de Rochas enunciated the four-stroke cycle.

The programme included some ninety papers, all to be submitted and discussed within a few days; it involved many difficulties and adequate justice could not be done to such a torrent of contributions in the comparatively few hours available. Moreover, it is a disadvantage inherent to the simultaneous discussion—by groups—of a variety of papers, that no one man

can be present at two sessions which run concurrently. This difficulty becomes peculiarly manifest where the entire gathering is dealing, more or less exclusively, with a single category of heat engines. It might, indeed, be argued that with the complexity and specialisation of function which is characteristic of the present phase of internal combustion engine development, there is scope for a plurality of international congresses each dealing with a single element or with a special category of engines. But are there not too many conferences already? How could so many more be attended? Yet we are reminded here of the story of Agassiz, the great zoologist, who was asked, by the organisers of an evening school for tradesmen, to give them a lecture on fishes. Agassiz declared it to be a thing impossible but he consented to deliver a lecture on a fish scale! This is something which conveys guidance to the organisers of such meetings as the one with which we are now dealing and the experience acquired at the recent Congress in Paris should prove valuable in its application on future occasions. While a great deal of the discussion which took place in Paris was devoted to the more academic questions relating to vibrations, critical speeds and other important design considerations, practical research and testing were authoritatively dealt with. A group of four papers related to piston-rings and special attention was given, in other papers, to rail traction, marine engines, welded construction, scavenging, pressure-charging, coupling and transmission systems, crankshaft corrosion, cast iron crankshafts, fuel injection, burning of heavy fuels, crankcase explosions, free-piston generators, educational procedures, instrumentation and other subjects connected with the design, construction and maintenance of internal combustion engines. Very encouraging was the manifest willingness of engineers from all the industrial countries represented to put their views and experience at the disposal of world industry. Indeed, listening to the discussions, one realised how invaluable it is when experienced engineers meet together at an international level to discuss problems, the amelioration and solution of which is the common objective of all.

Even if technical unanimity is seldom reached, the value of technological discussion carried on with such marked cordiality cannot but be productive of engineering progress. That fact was brought out, among other instances, by the discussion on a paper dealing with the causes of crankshaft corrosion and in the discussions on rail traction. It is no easy matter to examine such questions multi-lingually but the system of translation used at the Congress, was very helpful, though this procedure—of repeating in another language the remarks of participants—absorbed a great deal of the short time available. It will surely be in the interest of technical progress if such congresses can be repeated—so long as there are not too many of them—and there would be advantage in holding sub-congresses dealing with specific matters covered in a symposium of papers. Even the adoption of such sectionalisation would not lessen the value of what might be called the ecumenical method, since the experiences, say, of a builder of traction type engines, has its lessons for the builders of all other types. Every serious piece of writing or discussion has the effect of promoting what the French call "éclairissement," a clearing-up of things. That, indeed, is the lesson of the international meeting in Paris and credit is due to the French engineers, who organised this Congress and who laboured with such assiduity and courtesy in the effort to make it as advantageous as possible to all participants.

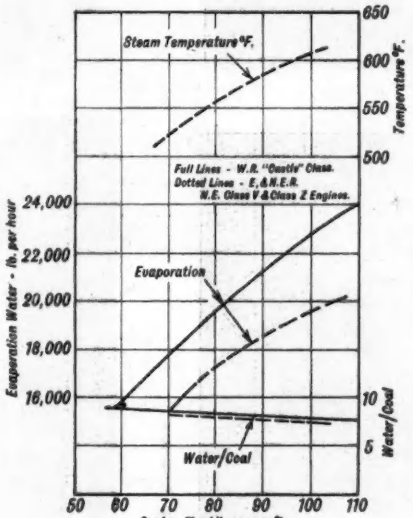
Letters to the Editor

(We do not hold ourselves responsible for the opinions of our correspondents)

"CASTLE" CLASS ENGINES, W.R.

SIR,—Mr. O. S. Nock has contributed to your columns a very complete record of the working of the "Castle" class engines and is to be complimented. The information concerning the evaporative performance of the boilers, as used for these engines, given in your issue of April 20th, is of particular interest.

To allow of a proper appreciation of these results information as to the calorific value of the coal fired is required. Can this be given? I assume the boiler performance applies to those as fitted by Mr. Collet, having the former standard fourteen-element superheaters; further, it would seem that the results are obtained from a curve of evaporations plotted against firing rates, coal pounds per hour, and are thus fair averages. In order to present a picture of the evaporative performance I have prepared the accompanying graph.



This shows the evaporation plotted against the rate of firing coal in pounds per square foot of grate area per hour and, in addition, the corresponding water/coal ratio. The relatively high values of the latter appear to indicate that coal of good quality was used even though the small superheater fitted would favour evaporative capacity. I have only plotted the evaporative performance for firing rates probably representative of everyday requirements. It will be noted that by the use of the straight-line relation between the water evaporated for each pound of coal fired, the water rate per d.b.h.p. can be added to Mr. Nock's Tables II and III.

On the same graph I have added further curves indicating the performance of another boiler. These are based on information given by Sir Nigel Gresley in a paper read before the Institution of Mechanical Engineers on "Three-Cylinder Engines, 1925." The tests were carried out by an old friend, T. Robson, a very experienced test engineer, and disclose excellent boiler performance with coal having a calorific value of approximately 14,000 B.Th.U. per pound.

The engines tested were of the two-cylinder and three-cylinder types, 4–4–2 classification, Class V and Class Z respectively. Boilers identical in each case based on Wilson Worsdell's original design of 1903 for his Class V "Atlantics." These boilers are characterised by their large deep fireboxes and long tubes, 16ft 2⅝in for 2in diameter outside. I have not plotted the boiler efficiencies, but, assuming coal of the quality stated, the efficiencies ranged from about 84 to 70 per cent at firing rates of 65 lb and 103 lb of coal per square foot of grate area per hour respectively. These values must be considered in conjunction with the steam temperatures plotted in the upper part of the graph.

Particulars of Boilers for N.E. Engines from Sir N. Gresley's 1925 Paper, Institution of Mechanical Engineers.—Dimensions of Heating Surfaces and Ratios

Locomotives	"Castle" class, W. Region	2 and 3-cyl. "Atlantics," E. & N.E. Region
Heating surfaces, square feet:		
Tubes and flues	1854·31	1298·4
Firebox	163·76	185·0
Evaporative	2018·07	1483·4
Superheater	262·62	392·0
Combined	2280·69	1875·4
Grate area	29·36	27·0
Ratios:		
Firebox H.S./evap. H.S., per cent	8·00	12·48
Firebox H.S./grate area	5·57	6·85
Superheater/combined H.S., per cent	11·48	20·9
Evap. H.S./grate area	69·5	55·0
Comb. H.S./grate area	77·7	69·5

The tabulated statement herewith sets out certain particulars of the two different boilers concerned in the foregoing.

E. C. POULTNEY

London, N.W.3, May 5th.

The Vickers "660" Four-Jet Bomber

IT has been announced by Vickers-Armstrongs, Ltd., that the Vickers "660" bomber aircraft, fitted with four Rolls-Royce "Avon" turbo-jet engines, made its first flight on May 18th. This is the first of the four-jet bombers now under development in this country to have flown and one to which frequent references have recently been made in the House of Commons. It is also stated that a substantial order has already been placed for this machine. The aircraft has a high swept-back wing, into which the engines are submerged, and a tricycle undercarriage of six wheels in pairs. No further details are given.

New Power Stations at Blaydon-on-Tyne

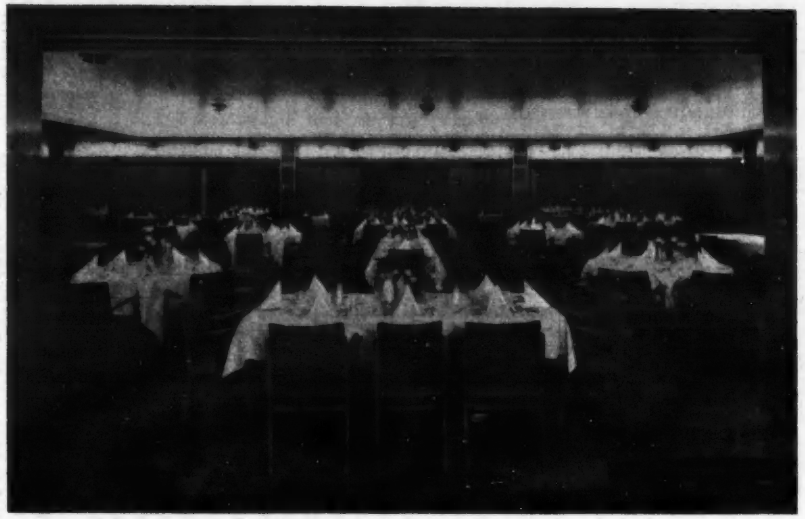
THE British Electricity Authority has received from the Minister of Fuel and Power consents for the establishment of two new power stations at Blaydon-on-Tyne, Durham. The two new plants will be known as the Stella North and Stella South power stations. The consent for the former covers the installation of four 60MW turbo-generator sets, four boiler units, each of an evaporative capacity of 550,000 lb of steam an hour and four cooling towers, and the consent for the latter covers five 60MW sets and five boiler units, each of an evaporative capacity of 550,000 lb an hour. The ultimate installed capacities of these stations will, therefore, be 240MW and 300MW respectively.

ROYAL MAIL STEAMER "ORONSAY"

VICKERS-ARMSTRONGS LTD., BUILDERS

FIRST CLASS LOUNGE

VERANDA BAR



FIRST CLASS DINING ROOM

TOURIST "B" CLASS DINING ROOM

R.M.S. "Oronsay"

No. I

ON Wednesday, May 16th, the R.M.S. "Oronsay" sailed from Tilbury on her maiden voyage to Australia, via the Mediterranean and Colombo. She is the biggest vessel to be completed this year, the latest vessel to carry the house flag of the Orient Steam Navigation Company, Ltd., and the second ship to bear her name. It is taken from one of the Western Isles of Scotland, and she wears a broadsword and targe as her badge. Built and engined by Vickers-Armstrongs, Ltd., at its Barrow yard the twin-screw turbine-driven "Oronsay" was launched in June last year, and replaces the first ship of the name which was completed in 1924 and sunk in October, 1942, while on war service.

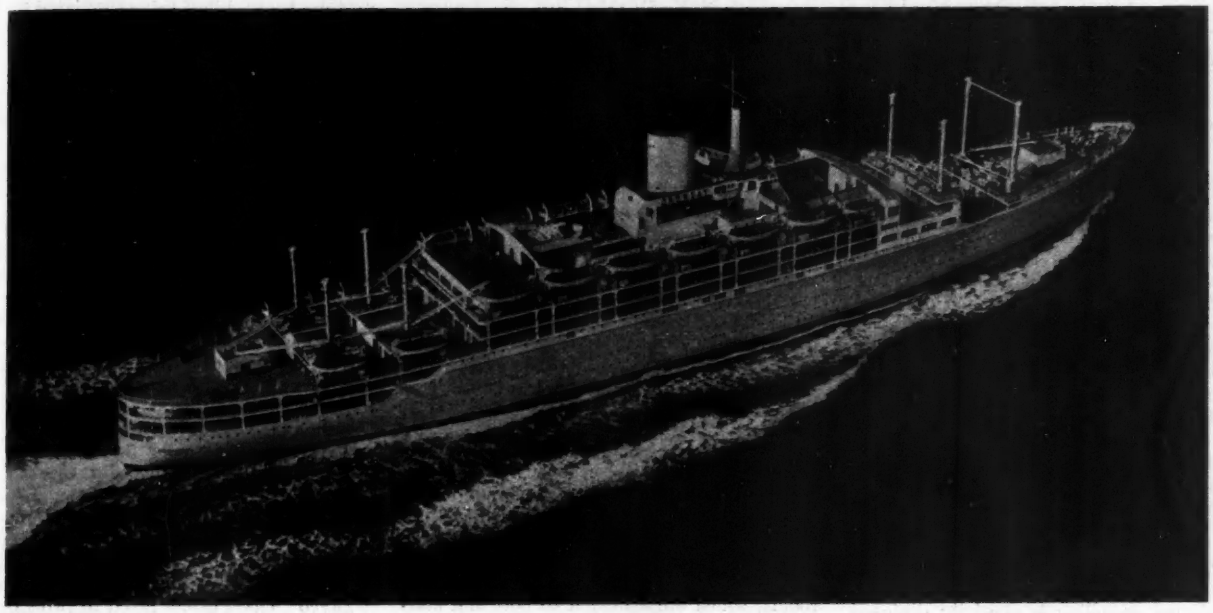
It will be seen from the accompanying illustration that the vessel closely resembles the "Orcades" in profile and retains the distinctive feature of a large funnel associated with a superstructure embodying the bridges and officers' quarters, together with a single mast stepped on the compass platform. In "Oronsay" the most noticeable difference is that the funnel casing is larger and lower, and the mast is built up, streamlined, and incorporates the radar scanner.

The ship has been built under the Survey of Lloyd's Register of Shipping to its highest class and conforms with all the latest requirements of the Ministry of Transport, including the international regulations for safety of life at sea.

On the voyage from Barrow round to Tilbury the vessel ran trials over the Polperro course and a speed of 25·23 knots was recorded as the mean of two double runs, while the highest speed attained was 25·8 knots. With this reserve of power there should be no difficulty in maintaining the service speed of 22·5 knots.

There are eight decks occupied by the passengers and crew, with the first-class passengers placed amidships, the tourist "B" passengers aft, and the crew forward. The accommodation has been arranged to provide the maximum of comfort and the extensive ventilation and air-conditioning systems ensure that equable living conditions are maintained over the range of climatic changes encountered on the voyage to Australia. For both classes of passengers a generous amount of deck area has been reserved for the playing of games and for leisure. Some of the spaces are open, while others have portable wind protection screens to form enclosed sports arenas.

In conformity with the builders' present practice, for which the shipyard has been specially reorganised during recent years, the ship is mainly of welded construction. Large sections, including main bulkheads and panels of decks, weighing up to 40 tons each, were prefabricated on the ground and skids before being placed in position on the building berth. Riveting has been employed as a method of joining for such parts as the seams of shell plating, side frame connections to the shell and minor constructional items.



R.M.S. "ORONSAY"

General Particulars

Length overall	708ft 8in
Length between perpendiculars	668ft
Breadth moulded	90ft 6in
Depth moulded to "E" deck	50ft
Draught	31ft
Gross register tonnage, approx.	27,650 tons
Service speed	22½ knots
General cargo, cubic feet	120,000
Insulated cargo, cubic feet	223,000

Accommodation

First-class passengers	668
Tourist "B" class passengers	833
Crew	622

Propelling Machinery

Type: twin-screw, double-reduction geared Parsons turbines of Pametrada design.
Normal power: 34,000 s.h.p. at 130 propeller r.p.m.
Overload power: 42,500 s.h.p. at 140 propeller r.p.m.
Astern power: 65 per cent of normal ahead power.
Steam supply: 500 lb per square inch gauge at 850 deg. Fah.
Boilers: two large and two small Foster-Wheeler of controlled superheat design.
Superheat range: 850 deg. Fah. down to 600 deg. Fah.
Steam pressure: 525 lb per square inch.

Electrical Machinery

Type of generators: four W. H. Allen turbo-generators.
Rating: 850kW, 220V d.c.
Overload: 1060kW for two hours.
Emergency: two W. H. Allen diesel-driven generators.
Rating: 100kW, 220V d.c.

Decks "D," "E," "F," "G" and "H" extend for the full length of the ship; "C" deck has a break aft of the forecastle, while "A" and "B" decks form the superstructure. There is an orlop deck in No. 1 hold, and "J" deck forms the tunnel top. The continuous double bottom is of cellular construction and divided into a number of watertight compartments, which, together with the fresh water tanks at the sides of the engine-room and oil fuel tanks in the boiler-room wings, form a double skin over the length of the machinery spaces. Subdivision is effected by eleven watertight bulkheads.

First-Class Accommodation

The first-class cabins are arranged in the deck-house on "C" deck and on "D," "E" and "F" decks, practically all are one or two-berth rooms with a few special three-berth cabins for families. Many rooms have private bathrooms or showers and most of the inboard and many outside cabins are air conditioned. To starboard on "D" deck there is an air-conditioned luxury flat and also on this deck are fourteen special two-berth air-conditioned staterooms, all having large windows.

The boat or "A" deck is mainly laid out for sporting activities. In front of the bridge is the sports arena which has folding glazed screens to port and starboard, and a verandah aft which serves as a shelter for spectators. Forward of the arena is a sheltered and comfortably furnished look-out which has a raised deck and which gives views forward and overside through long, vertical, sliding windows. The steel structure is designed to deflect the wind upwards and over the arena. The starboard space beneath the bridge is used as a library which has a single low window and has an altar fitted in a recess so that the room can be used for church services. Two games spaces are arranged one on each side of the funnel casing, abaft of which, on the centreline, is a raised and covered grandstand for spectators. The restaurant with its attendant kitchens occupies the after end of the deck and the space is noteworthy for the wall decoration which consists of intricate line drawing in the form of "doodling." The top of the restaurant deck-house forms another games

area which is shielded from the wind by a steel deflector screen.

Right forward of the promenade or "B" deck is the completely separate children's playroom, open deck playground, sand pit and paddling pool. Double doors to port and starboard lead aft through a small lobby either to the promenade space or to a main lobby which opens on to the roomy lounge complete with bar. Here there is a mural based on the decorative patterns of inn signs and having as a background a famous country house, "Audley End." On either side of the casing, galleries, panelled in elm boards, continue the comfortable furniture of the lounge and lead to the dancing space, which is a solarium by day, with sliding and folding glass screens to give protection from bad weather, and is also equipped as a cinema. Right aft is the verandah bar overlooking the swimming pool on "C" deck. The bar has an an air of a retired sea captain's room with its prints of famous sailing ships and early steamships set in wall recesses. The centre piece is a model of the "Orient," a clipper of 1032 tons, having a length of 190ft, a beam of 35·6ft, and a depth of 21·5ft. She was built in 1853 by Thomas Bilbe and Co., at Nelson Docks, Rotherhithe, and the Orient Steam Navigation Company took its name from the vessel.

Amidships on "C" deck and opposite the main staircase is the shopping centre behind which is the hairdressing saloon, and right aft is the tavern which opens out on to a swimming pool flanked by dressing rooms. Two decks down on "E" deck is the foyer, which is the main embarkation point, and two lobbies lead to doors in the ship's sides. A stairway leads from the foyer down to the spacious air-conditioned dining-room on "F" deck, which has bays arranged in the wings to take away the appearance of great size. There is a separate children's dining-room to port and an auxiliary dining-room to starboard, each seating twenty, while the main room has a capacity of 320 tables to seat two, four, six and eight. The slatted panelling is specially designed, in association with the acoustic ceiling, to absorb the sounds which arise inevitably in a room of this size. The decorative feature is an illuminated amber and white glass transparency.

Access to the accommodation is by means of an amidship tee-shaped staircase, flanked by two lifts, which extends from the boat deck to the dining-room on "F" deck, and links together lobbies at each deck level. Another staircase forward commences at "F" deck and rises through the accommodation to the sports arena at "A" deck. Aft wing staircases start at "A" deck and form a link between the restaurant, verandah bar and tavern, while a centre-line stairway continues downwards to give access to the cabins on "D" and "E" decks.

Tourist "B" Class Accommodation

All the cabins are sited on "F," "G" and "H" decks, and are arranged as two, three, four and six-berth rooms. A high level of comfort is maintained, but the equipment is to a basically simple standard. Many of the six-berth rooms, which come within the lower scale of fares, have communal washrooms and so ensure the maximum of space in the cabin. The sun or "C" deck is arranged for deck games and there are a swimming pool and dressing rooms. The verandah on "D" deck, which is over 100ft long, has hinged protective screens, serves as a sun trap by day, and is available for dancing at night. Right aft on this deck is a space, reserved exclusively for children, with play room, open-air space, sand pit and paddling pool. A bright and attractive lounge is situated on "E" deck. It has a shop at one end and the sides are divided into a number of recesses for the convenience of small parties. An aft stairway connects the accommodation decks with the public rooms and sports deck, and another main staircase, at the forward end of the lounge, extends down to "H" deck to give access to the library on "F" deck. The library serves as a foyer to the dining-room, which is panelled in teak and blue plastic and can seat some 390 diners.

The whole of the interior design and decoration has been the responsibility of Mr. Brian O'Rorke, and some of the public rooms are shown in our illustrations on page 688.

Crew Accommodation

The ship's staff is comfortably housed, all the officers having single-berth rooms, while the petty officers and leading hands are in two-berth cabins. Navigating officers' quarters are on the third bridge, while the captain and staff commander have suites on the second bridge. The engineers have their cabins, mess and sitting-rooms arranged to starboard abreast the engine casing on "E" deck. The cabins for leading hands are forward on "D" and "E" decks, and they have an air-conditioned mess and sitting-room on "G" deck. Forward on "E," "F" and "G" decks the crew is quartered, the air-conditioned mess being to starboard on "G" deck, and a recreation space forward on "D" deck.

Hotel Services

The galley is placed between the first and tourist "B" class dining-rooms on "F" deck. The centre space between engine and boiler casing is occupied by two twelve-oven island ranges and other units are located in the various auxiliary food-preparation rooms, which are arranged to port and starboard along the ship's side. The galley, which is mainly electric, can serve 6400 meals daily, and the connected load of the equipment, mainly supplied by Henry Wilson and Co., Ltd., is approximately 800kW.

On "F" deck aft there is a well-equipped laundry which is able to deal with all the ship's linen and the passengers' requirements, and the fittings include hydro-extractors, washers, power-operated presses, an "Air Speed" dryer, and a shirt and collar machine. Additional facilities are made available for the passengers by the provision of ironing rooms throughout the accommodation.

On the port side of "E" deck there is an air-conditioned general hospital, consisting of three wards, a nursing ward and a maternity ward, together with an operating theatre and consulting room, and right aft on this deck is a self-contained isolation hospital.

The two passenger lifts, which have already been mentioned, can be either hand or automatically controlled, and have power-operated doors, and floor levelling gear. Additionally, there are an engineers' lift, a lift for pantry service, and another for food service, all supplied by J. and E. Hall, Ltd., and two electro-hydraulic stores lifts manufactured by MacTaggart Scott and Co., Ltd.

The cabin telephone service is catered for by a 500-line manual exchange board, and six shore lines are provided for use in port, while there are a number of kiosks and coin box telephones. For the ship's staff a separate automatic switchboard is supplied complete with tie lines to the manual exchange.

Ventilation

Thermotank, Ltd., has supplied the complete ventilation system for the cabins, public rooms and crew's quarters, and it consists of a total of ninety-seven fans, requiring 454 h.p. Steam is employed as a heating medium to maintain a temperature between 65 deg. to 70 deg. Fah., and solenoid-operated steam valves are controlled by thermostats in the supply tanks. Several units, which supply air to the accommodation on "G" and "H" decks aft, are fitted with "Ozonair" equipment. For the air conditioning of the public rooms, certain passengers' and officers' cabins, hospital and mess spaces, twelve fans are in use. The installations maintain definite conditions of temperature and humidity, the cooling medium being chilled brine circulated through air coolers from steam jet vacuum refrigeration plants. Two sets, supplied by Foster-Wheeler, Ltd., are fitted, one forward and one aft, each having a capacity of 2,500,000 B.Th.U. per hour. The automatic control is of modulating design, electrically operated, and includes suitably placed thermostats controlling motorised valves and dampers.

Deck Machinery

The three forward holds and 'tween decks are insulated and have a capacity of 223,000 cubic feet of refrigerated cargo. Over the refrigerating machinery room are the insulated stores and one compartment is arranged for ultra low temperatures. General cargo is carried in Nos. 4, 5 and 6 lower holds, the capacity being 120,000 cubic feet. For handling the cargo there are two 20-ton, two 10-ton and twenty 5-ton tubular steel derricks, served by eight 5-ton Clarke Chapman winches and sixteen 3-ton Laurence Scott winches. The working and mooring of the ship is effected by a Clarke Chapman electric windlass with capstan heads driven by 112 b.h.p. motors to take 3½in diameter "Tayco" chain cables fitted to two stockless bower anchors, each weighing 165 cwt. With two motors running the windlass exerts a pull of 90 tons at 21ft per minute, and the capstans 19½ tons at 45ft per minute. Two warping capstans are mounted aft, each driven by a 64 b.h.p. motor and exerting a pull of 18 tons at 35ft per minute. Steering is by an electro-hydraulic, four-ram gear, supplied by Brown Brothers and Co., Ltd., and operated by telemotor and gyro control from the bridge.

Navigation and Safety Equipment

All the instruments essential for the refinement of navigation are fitted in the chart and wheel-house, such as a Chernikeeff log, rudder indicator and telegraphs. There is a Sperry gyro compass with electronic amplifier follow-up system, bearing repeaters and course recorder. Marconi marine radar, direction finder and echometer are fitted and three sets of radio equipment, which enable the vessel to maintain world-wide communication.

The recommendations of the International Conference for Safety of Life at Sea are incorporated throughout. There is adequate subdivision, and cross levelling arrangements are provided to correct quickly any list caused by damage to a wing compartment. Three Stone's electrically operated vertical sliding watertight doors are provided. Elaborate fire precautions include internal steel staircases, fire screen doors and bulkheads, an automatic fire alarm system, a complete installation of Grinell sprinklers, and a Lux-Rich fire-detecting system is

provided in the cargo spaces, while the steam supply is readily available in holds and 'tween decks.

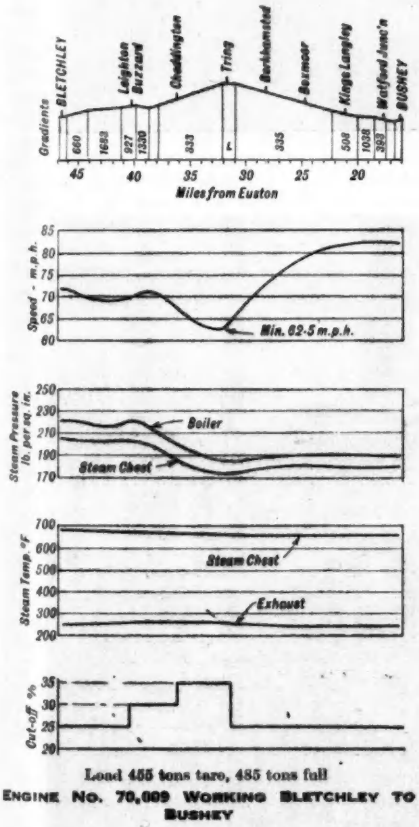
Steel lifeboats carried under Welin McLachlin gravity davits are capable of carrying everybody on board. The complement of lifeboats consists of ten 36ft boats, each accommodating 145 persons; two 36ft motor lifeboats, each to carry 136 persons; four 31ft, each with a capacity of ninety-nine persons, and two 26ft emergency boats, each to carry forty persons. With the exception of the motor boats the lifeboats are fitted with Fleming hand propelling gear.

(To be continued)

The "Britannia" Class Locomotives on Test

By O. S. NOCK, B.Sc., A.M.I.C.E., M.I.Mech.E.

FOLLOWING upon Mr. E. S. Cox's paper on British Standard Locomotives and the publication of drawings of the "Britannia" class "Pacific" engines, there has been a natural curiosity among engineers to know how far the aims and ideals of the designers has actually been fulfilled in the performance of the new locomotives. Accordingly, an invitation from the Railway Executive to representatives of the technical press to attend a demonstration on Friday, May 18th, was very much appreciated, all the more so in that this demonstration was one of a very practical kind. Not only were we privileged to see one of the new engines in action at the Rugby Testing Station but it was arranged for another engine of the class to work the trains by which the party travelled to and from Rugby. In both directions a dynamometer car was attached, so that the road performance of the engine could be better appreciated.



Load 455 tons tare, 485 tons full

ENGINE NO. 70,009 WORKING BLETCHLEY TO BUSHEY

The engine observed on the Testing Station, No. 70,005, "John Milton," is undergoing a complete series of tests to determine the performance characteristics over the full range of working conditions. The method of testing is that which has been developed on the Great Western Railway, at Swindon, namely, the maintenance of a constant rate of evaporation during each individual run of two hours' duration. Tests have already been made at successively increasing rates of evaporation up to the high maximum of 33,000 lb of steam per hour; and at each rate test runs were made at different combinations of speed and cut-off so that, from the points obtained, a characteristic curve could be drawn, showing the power output throughout the whole range of working, and the corresponding cost in coal and water consumption.

During the relatively short time available in our visit to the testing station opportunity was taken to demonstrate two different conditions of running at a moderate rate of evaporation of 20,000 lb of steam per hour, in the one case heavy working up a bank and in the other fast running on the level. The test conditions were:—

Test	1	2
Approximate speed in miles per hour	25	75
Approximate cut-off	40 per cent	22½ per cent
Evaporation, pounds per hour	20,000	20,000
Firing rate, pounds per hour	2,520	2,520
Coal, pounds per square foot of grate area, per hour	60	60

The performance was equivalent to the haulage of a train load of 500 tons, on Test 1, up a gradient of 1 in 90, and in Test 2 on level track. At Rugby the horsepower measured is that at the driving-wheel-rim—something between the indicated and the true drawbar horsepower. In the two tests demonstrated the rim horsepower was approximately 1240 in Test 1, and 1450 in Test 2. The coal fired was Grade 1A South Kirkby hard; this grade, it will be recalled, was used in the express engine tests in the interchange trials of 1948. A relatively thin fire was being maintained. The power developed from this moderate rate of firing is impressive, when it is remembered that this engine has successfully maintained an evaporation rate of 33,000 lb of steam per hour during the standard two-hour test period.

In the tests witnessed best quality coal was being fired, but a parallel series of tests with low-grade coal is already in hand. In addition, it is intended that a further series of characteristic curves will be obtained, showing the performance of the engine when in the most run-down condition that it would be accepted for first-class duties. Eventually, therefore, performance data will be available for every standard engine class using high-quality and low-grade coal, and the engine itself in good and run-down condition. From this information it is proposed to define to the operating department the most economical times and loads for each class of engine on the various services they are required to work. In the case of Engine No. 70,005, "John Milton," it is intended that when the tests at Rugby are completed (excepting, of course, those in run-down condition, which cannot be made for some time) some additional tests shall be carried out on the line with the dynamometer car, by way of verification. They will be made on the former Midland line, between Leeds and Carlisle.

North-Bound—Euston to Rugby

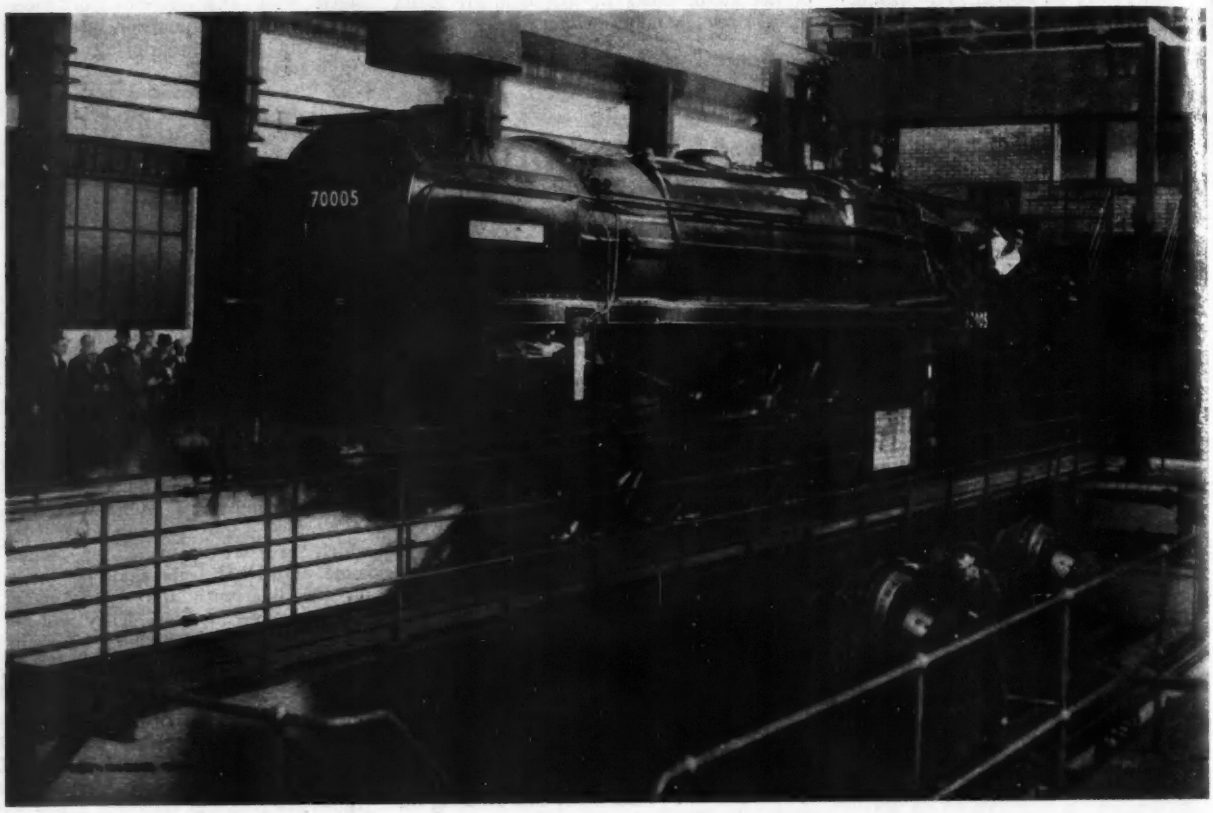
Travelling north, two extra coaches and the dynamometer car were attached to the 10.30 a.m. express from Euston to Liverpool. This train does not normally call at Rugby, but on this occasion it was stopped specially. Ninety-five minutes were allowed for the run of 82·6 miles, an average speed of 52·2 m.p.h., but two severe temporary speed restrictions were in force, for relaying work. In addition, however, there was a Liverpool Boat Special leaving Euston at 10.20 a.m., and this train proved a further source of delay. On this account the journey took 99½ min. It was, however, a journey of much interest, as the work of the locomotive could be watched from the dynamometer car and on the uphill stretch from Watford to Tring the work was an impressive foretaste of what we were to see later in the day. The engine used was No. 70,009, "Alfred the Great," and the load, 485 tons tare behind the tender. The gross load would be about 515 tons. The old Lancashire and Yorkshire Railway dynamometer car was used; in this engine the drawbar pull and the buffing loads are recorded, but the drawbar horsepower has

Summarised Log of Run from Rugby to Euston.

Distance (miles)		Booked time, p.m.	Actual time, (to nearest half-minute)	Speed, Point to Point	
				Booked	Actual‡
0·0	Rugby	3.18	3.27		
				51·6	44·0*
19·8	Blisworth	3.41	3.54		
				58·0	61·0
22·7	Roade	3.44	3.57		
				61·0	72·5
35·9	Bletchley	3.57	4.8		
				53·0	67·2
50·9	Tring	4.14	4.21½		
				65·6	75·8
65·1	Watford	4.27	4.32½		
				66·0	75·3
77·2	Willesden Junction	4.38	4.42½		
				23·1†	27·0§
82·6	Euston	4.52	4.54½		

* Includes relaying slack at Weedon.
† Includes five minutes' recovery time.
‡ Actual speeds calculated from times in seconds.
§ Includes three minutes' standing at signal.

"BRITANNIA" CLASS LOCOMOTIVE AT RUGBY TESTING STATION



to be calculated. In the latest dynamometer car used with the L.M.S. Mobile Test Plant, the drawbar horsepower can be read off directly. In the L. and Y. car observers are in touch by telephone with another observer on the footplate and details of engine working are recorded at intervals. During the fast climb from Watford to Tring, when this stretch of 14·2 miles was covered in 13¼ min, at an average of 63 m.p.h., a typical set of readings was :—

Boiler pressure	230 lb per square inch
Steam chest pressure	218 lb per square inch
Cut-off	29 per cent
Temperature :	
(a) In steam chest	702 deg. Fah.
(b) Of exhaust steam	260 deg. Fah.
Drawbar horsepower (actual) ...	1340

The maximum speed noted on the northbound run was 74 m.p.h., on the down gradient from Tring, before an adverse distant signal was sighted nearing Cheddington.

Rugby to Euston

The southbound run proved to be of far greater all-round interest. The special portion was attached to an express from Wolverhampton, having a booked time of 94 min from Rugby to Euston; but a departure 9 min late gave an excellent opportunity of showing what the new engine could do, again with a heavy train of 455 tons tare, about 485 tons gross, behind the tender. There was a bad slack for relaying for ¾-mile, at Weedon, but otherwise a good road was obtained until the final approach to Euston.

But apart from any questions of speed, conditions developed on the footplate to demonstrate the work of the engine under just those unfavourable circumstances that the design has been prepared to counter. After about 45 min running from Rugby, the fireman dug down to a layer of dirty coal, with the result that the pressure fell from the rated 250 lb to no more than 185 lb per square inch. On some locomotives a drop in pressure from 250 lb to 185 lb per square inch with such a load as 485 tons would have been crippling; but so ample was the margin of power in reserve that a high average speed was maintained—72·6 m.p.h. for a stretch of 50 miles on end. The diagram opposite has been prepared from a series of notes taken while travelling in the dynamometer car. Normally, the engine was worked in 25 per cent cut-off but it will be seen that, when the pressure was falling, the cut-off was increased, first to 30 per cent and then to 35 per cent, and Tring summit was passed at more than 60 m.p.h. Nearing Tring the d.h.p. uncorrected for gradient was approximately 1250. Downhill the engine ran freely at speeds slightly exceeding 80 m.p.h. From the elevated seats in the front of the dynamometer car the smooth riding of the engine could be observed and, taken all-round, the performance was a very fine one.

As regards general performance in service the pioneer engine of this class, No. 70,000, "Britannia," made a round trip from Crewe to Carlisle and back in January, 1951, on which the coal consumption averaged 3·1 lb per drawbar horsepower hour, while an indication of water consumption is given by the fact that Engine No. 70,009 ran a train of 384 tons non-stop from Crewe to Euston, 158 miles, without taking water at any of the intervening water-troughs. The tender was nearly empty on arrival but the average consumption had been no more than 26 gallons per train mile.

Reverting to the demonstration run on May 18th, the accompanying log shows how time was steadily regained and the arrival in Euston would have been about 2 min. early had not the train been stopped by signals outside and held for 3 min.

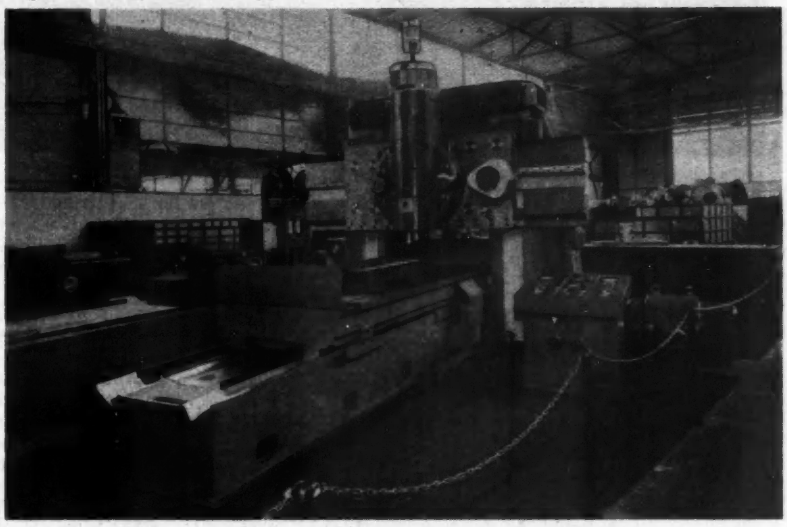
The actual time from leaving Rugby to the stop ¼-mile out of Euston (82·1 miles) was 81¼ min, and the fastest stretch, 50 miles between mileposts 60 and 10, was covered at 72·6 m.p.h. average, despite the fact that for most of this distance the boiler pressure was much below normal. The engine was worked by Driver Munslow and Fireman Freshwater, of Canadian Motive Power Depot, accompanied by Locomotive Inspector Drury.

By those who took part, the occasion will be remembered for the delightfully informal and informative way in which Mr. Riddles himself, Mr. R. C. Bond, Mr. E. S. Cox, Mr. D. R. Carling, Superintending Engineer at Rugby, and other members of the Railway Executive staff acted as hosts, not only at Rugby itself but throughout the day.

Hanover Technical Fair

No. II—(*Continued from page 657, May 18th*)

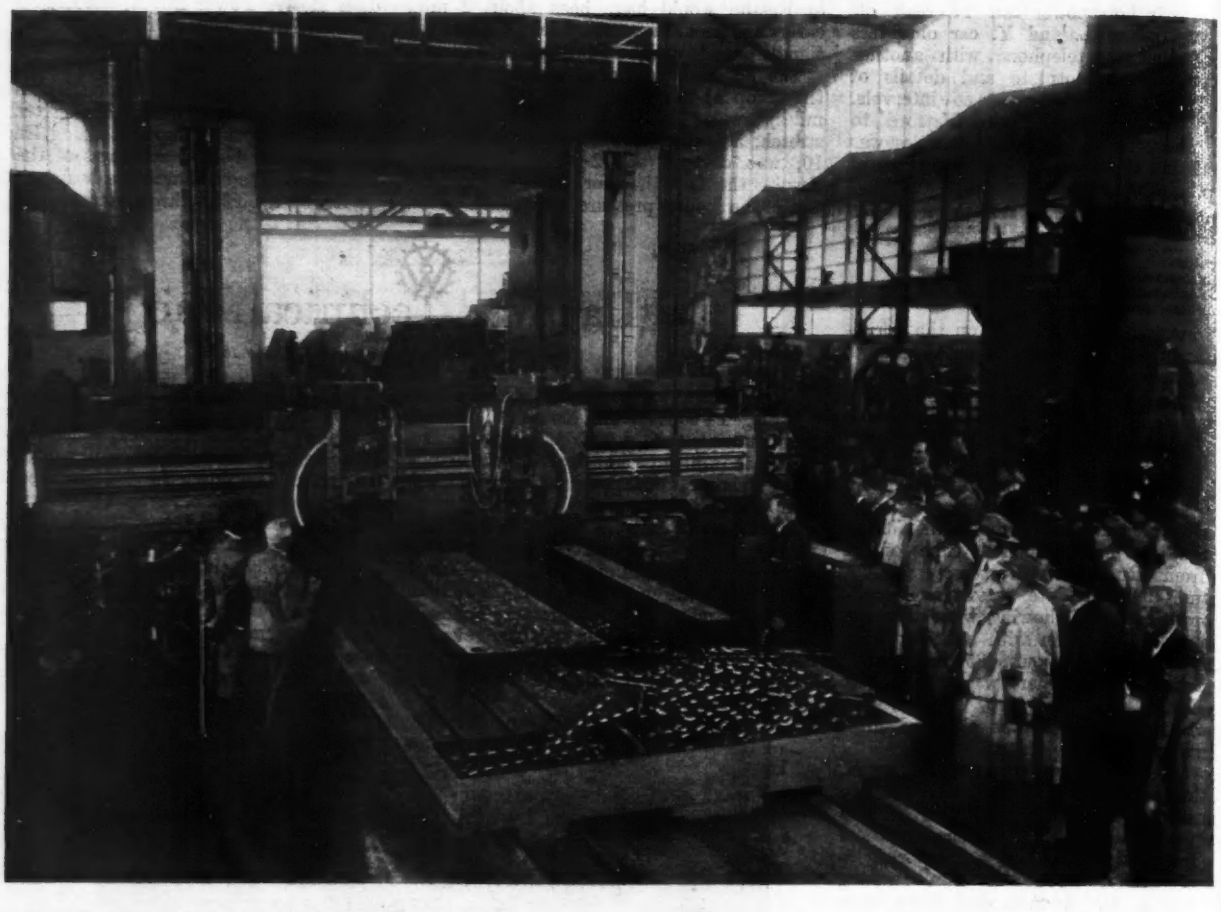
AN outstanding example of Waldrich-Siegen construction was the firm's new multiple-tool double-planing machine, which is still in the experimental stage. It was shown at Hanover after successfully completing several months of running in the company's experimental and research department. It has been specially designed for the economic machining of steel blooms. A view of the new planer is reproduced herewith and a sectional drawing showing the general construction of the reversing head is given overleaf. The usual tool box, it will be noted, has been replaced by a round section reversing column, which is split longitudinally. This column is firmly seated in the head casing and at the lower end of the two halves are the tool holders and tools. As seen in the drawing, there are three tools, arranged in series. At the end of each table motion the column reverses and puts the free set of tools into its working position, thereby continuing the cutting operation, where the other tools stop. When reversing, the non-working tools are lifted well clear of the workpiece, so that possible damage to the cutting edges from chips is avoided. A vertical motor on the top of the reversing column drives it through a pinion and gear. By making a slight deviation from the main direction of cutting, by adjustment of the column, any desired depth of tool cut can be obtained. Double sets of tools are only used on plain surface work, whether in the horizontal, inclined or vertical position on the table. For profile work only one set of tools working in either direction of motion is required. The feed for the reversing head is given by built-in three-phase motors, working with a rack and pinion, while when planing vertical or inclined surfaces the feed is effected by adjustment of the reversing column. To prevent any yielding of the tools or head during the cutting operation, the head is automatically clamped to its guides, and the reversing column to its casing. Both parts are automatically freed during the reversing movement. Experience when working with this machine, the firm states, not only proves that planing in both directions is possible, but that it is the most economical method.



Multiple-Tool Double Planer—Waldrich

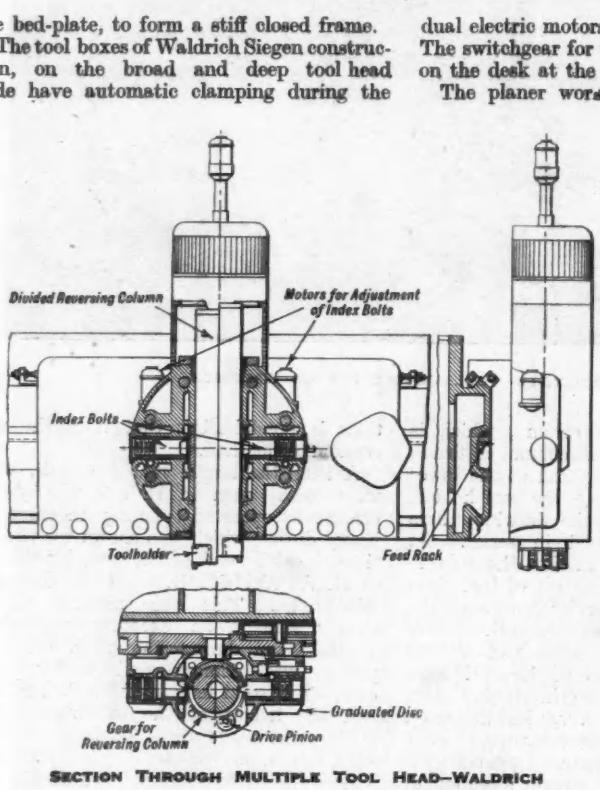
Among the larger machine tools, which were to be seen in Hall 3, was a fully electrically operated planing machine for heavy duties, which was shown for the first time since the end of the war, by the firm of H. A. Waldrich G.m.b.H., of Siegen, in Westphalia. This large machine can be clearly seen in an accompanying photograph, taken during the Fair, when the planer was demonstrated taking heavy cuts. The total length of the bed is 21m, and the height of the columns is 10m. On it components up to 8m long and 2·8m wide can be machined. The bed-plate is of a deep ribbed construction, which has been developed to avoid deflection when the machines are installed in districts where mine subsidence may occur and bring about foundation troubles The two side columns and the top rail are all of box form construction and are bolted together and to

WALDRICH DOUBLE COLUMN PLANER



the bed-plate, to form a stiff closed frame.

The tool boxes of Waldrich Siegen construction, on the broad and deep tool head slide have automatic clamping during the cutting stroke the tools being lifted before the return stroke begins. If desired the tool boxes can be inclined to an angle of 30 deg. A prominent improvement is the almost total absence of all hand wheels, which have been replaced by switches operating individual electric motors for the various motions. The switchgear for the motions is centralised on the desk at the side of the machine.



SECTION THROUGH MULTIPLE TOOL HEAD—WALDRICH

The planer works on the Ward-Leonard principle, which provides a wide and stepless range of speed control.

Among the gear cutters a new semi-automatic gear cutter was to be seen on the stand of Maschinenfabrik Rudolf Staehely of Wüppertal-Nächstebreck. Two machines were on view, the S.H.500, an improved model of the original machine, and the S.H. 250 model, with semi-automatic operation. The machines have a closed-frame structure, in which the milling head carrying the hob is arranged horizontally and the work spindle vertically. The machine is designed to cut spur gears, screw gears and worm gears, as well as splines. The milling head can work in either direction and all its feed controls are neatly grouped together on a panel. The capacity of the large machine is such that it can be used to cut 500mm dia. spur gears, with a tooth depth up to 240mm. It can also cut screw gears up to 275mm dia. and splines down to 15mm dia. The milling head can be swung through 180 deg. The feed of the hob is stepless from 0mm to 6mm per minute and the vertical feed of the workpiece 0mm to 12mm per minute. Rapid traverses of up to 300mm per minute and to 600mm per minute are available for the milling head and the work spindle, respectively. The main motor for this machine has a power of 4kW at 1400 r.p.m. and smaller motors serve the hydraulic feed system and the coolant pump.

The semi-automatic SH250 model has capacity for spur gears of 250mm dia. with tooth depths up to 300mm. Large screw gears and splines can also be cut. It has six spindle speeds and the speed of the milling head can be varied between 70 r.p.m. and 280 r.p.m. The feed for the hob is variable from 0·30mm per minute and rapid traverse for the workpiece and the milling head are both set at 400mm per minute.

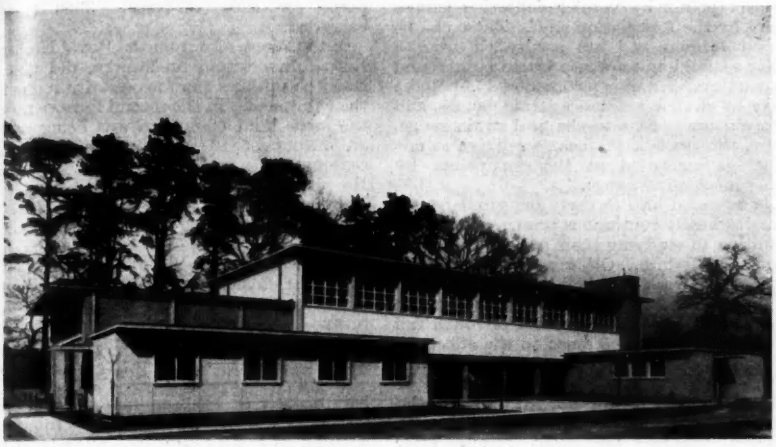
With this machine, once the work has been set and the feeds and speeds selected it is switched on and the hydraulic pump started, after which all movements are automatic and the machine stops when the work is completed. The representatives of Rudolf Staehely in England are Lerche Machine Tools, Ltd., of Oakwell Gate, Gateshead-on-Tyne, 8.

(To be continued)

SEARCH FOR OIL.—Two test wells—"wildcats"—are being drilled by the Shell Petroleum Company, Ltd., at Bulak Setap and Subis, in Sarawak, British Borneo, and drilling rigs capable of reaching a depth of 10,000ft are being used. The test well at Subis is already over 1000ft deep, while it is expected that the well at Bulak Setap will be "spudded in" very shortly.

The Structures Laboratory of the Cement and Concrete Association

ON Thursday May 10th, the new structures laboratory of the Cement and Concrete Association was formally opened by the Minister of Works, the Right Hon. G. A. Brown, M.P. The laboratory is the first of several new buildings planned at the Association's research station at Wexham Springs, Stoke Poges, Bucks. It is shown in the accompanying illustrations, which give an idea of the appearance of the building and the principal piece of testing equipment in the laboratory itself. The structures laboratory is 100ft long, 30ft wide and 26ft high, and is equipped with a 5-ton overhead crane. There is a precast concrete laboratory, measuring 30ft by 30ft, adjoining it, and various offices, &c., complete the building.



STRUCTURES LABORATORY AT WEXHAM SPRINGS

With the exception of the offices and lavatory blocks, where the walls are load bearing, the building is reinforced concrete framed; T-section columns and the roof main beams which they support, being spaced 10ft centre to centre along the length of the building. The columns were cast *in situ* and, besides carrying the roof, they support, at 15ft 5in above floor level, longitudinal beams for the running rails of the overhead crane, which is hand operated. The main roof beams, which were precast and pretensioned on the Hoyer system, have an unsupported span of 29ft 6in. They were tied to the column heads by ¼in diameter bars cast into their ends and linking with similar reinforcement left projecting from the columns. When the beams were placed on the columns these reinforcement bars were linked and the intervening space concreted *in situ*, with a projection that formed the flat overhanging eaves. T-shaped precast and prestressed roof joists span between the main beams and the roof infilling between them consists of unreinforced concrete blocks. The roofs of the precast products laboratory and of the offices and lavatory wings are all of 4in thick reinforced concrete slabs placed *in situ*.

In the framed main section of the building the walls are in general carried on ground beams that span from the point foundation of one column to that of the next. On the north side these walls have been built in brick to match the original brickwork of the walled garden area. On the south side they are constructed of 18in by 9in by 9in hollow concrete blocks. On both sides the solid walling only extends up to crane rail level, above which precast concrete framed windows are fitted between the columns.

The floor of the precast laboratory and the test floor of the structures laboratory are both structurally isolated by impregnated felt strips so that movement is not restrained and the transference of impact noise and vibration is prevented.

The name Wexham Springs is not without significance. When the floor was under construction water was encountered only 6in below ground level. For this reason the whole floor was tanked with bitumen, 1¼in thick horizontally and ¼in thick vertically.

The surface finishes of this building are of some interest. With the exception of the brick north wall, they are all basically products of cement, and full advantage was taken of this opportunity of demonstrating some of the colourings and textures that can be obtained with cement renderings as well as the different kinds of finish which can be given to concrete, both *in situ* and precast.

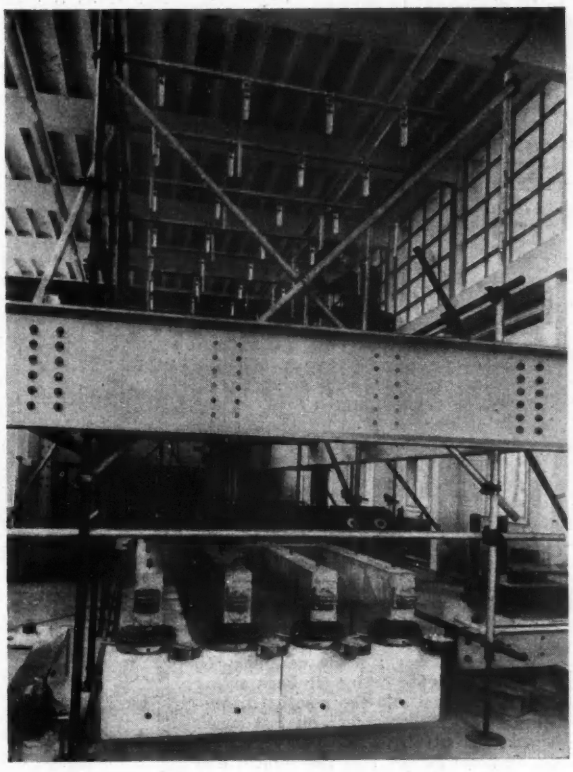
Renderings have been used on the two end walls of the structures laboratory as well as on the projecting stack and tank room, and on the side walls of the precast products shop. The two colours used are a soft greyish green and a dull pink. Corrugated asbestos cement sheeting finished with white cement paint is used as a cladding on the south wall of the structures laboratory between the sills of the high-level windows and the roof of the covered way. This roof is itself left as untreated concrete, while the columns that support it have a tooled finish. The lower portion of the wall that forms the side of the covered way is faced with precast slabs with a "ground" finish, there being a different texture in each of the panels. The products shop end wall is of precast blocks with an exposed aggregate finish. The office wing is faced with large precast slabs, tooled and resembling Portland stone in colour, and the lavatory block walls are of concrete bricks. The architect for the building was the late Mr. C. Nicholson, F.R.I.B.A.; the engineering consultant was Mr. W. A. Fairhurst, M.I. Struct.E.; and the main contractors were Holland & Hannen and Cubitts, Ltd.

TESTING EQUIPMENT

The lay-out of the structures laboratory has been arranged so that test specimens are cast at one end of it, and the instruments and apparatus are stored and erected and—as far as possible—operated at the other end. Materials tests in a 50-ton Denison "Universal" testing machine are also carried out at this end, and the main tests are carried out in the centre of the laboratory.

It was thought that the most economical method of carrying out a wide range of tests of large structural elements was to construct a universal testing machine capable of being arranged in as many ways as possible. The testing equipment, which is shown in our illustration, consists essentially of a base plate and a frame, so that loads can be applied by hydraulic jacks and the reactions taken by the frame. Part of the laboratory floor forms the base plate and has been isolated from the structure of the building by a bituminous joint. Deformation of the floor during testing will thus be independent of the rest of the laboratory. The "base plate" section of floor is of reinforced concrete, 2ft 6in thick and 40ft by 27ft in plan. Cast into the floor are 263 steel anchor sockets screwed with a 1½in diameter thread and designed to withstand an upward force of 5 tons. In order that the resistance of the test floor to sagging bending moments may be increased if necessary, ducts have been provided within the floor, through which prestressing cables may be passed. Pits at each end of the floor for stressing and anchoring the cables are covered with steel plating.

A system of steel columns and beams in which there have been drilled a number of hole



THE TESTING FRAME

patterns make up the parts of the reaction framework. The hole patterns enable the steelwork to be put together in a variety of ways for different tests and additional members or new frameworks may be added if needed. In general, the aim has been to make the testing

machine fit the test specimen rather than to have to restrict the specimen to an existing testing machine.

The framework can be erected to enclose the experimental structure so that point or distributed loads can be applied directly, and with slight adjustments it can be used for direct compression tests on columns or racking tests on frames. By erecting two separate frames and fixing a cross member on the experimental specimen to take the thrust of two jacks, torsion tests can be made. It is also possible to make tests on large beams by placing them sideways on the floor and loading them by jacks acting sideways and also anchored to the floor.

For the first tests that are being carried out the frame has been erected with four main beams (24in by 7½in R.S.J.), forming a rectangle supported by columns (8in by 3½in channel) at the corners, which are in turn attached to short ground beams (10in by 3½in channel). The whole frame is held down to the floor by a system of saddle beams (10in by 4½in R.S.J.), 2in diameter connecting-rods and welded distributing beams, each distributing beam picking up two anchor sockets. With this particular arrangement the whole frame is held to the floor by thirty-two anchor sockets.

The load is applied to the test specimen by hydraulic jacks which are connected to the main frame by 12in by 12in broad-flange beams, which provide a large seating area for the jacks. The main beams may be adjusted at heights varying from about 4ft 8in to 12ft from the floor by increments of 12½in, and the secondary broad-flange beams may be adjusted over a range of 9in by 3in increments.

The jacks are operated by a hydraulic system, fed by an axial plunger pump with a capacity of 938 cubic inches per minute and at pressures up to 4000 lb per square inch. The pump is driven by a 10 h.p. motor. The output of the pump is arranged in two separate deliveries of 750 cubic inches and 188 cubic inches per minute. The straining rates of the jacks can be adjusted by metering valves, which enable a predetermined amount of the flow to be discharged to exhaust. The equipment has been designed to operate six double-acting jacks, each with an independent pressure-reducing valve. Infinite variation of the force applied by the jack is allowed by the provision of a small back pressure. The jacks have a 6in diameter piston and a 4½in diameter piston-rod; they are designed to push with a force of up to 50 tons and are provided with detachable rings for pulling with a force of up to 21 tons. No attempt has been made to eliminate friction, but some care has been taken to obtain a good oil seal.

The line pressure is used to give an indication of the jack force, but for its accurate measurement pressure capsules are inserted between the jack and the specimen. The 50-ton capsules are made with the moving and fixed parts joined by bonded rubber. Tests on a 50-ton capsule with the load on the jack inclined at up to 5 deg. caused only slight tilting of the moving part, and the capsule measured accurately the normal component of the load applied by the jack.

For convenience of operation all the controls and gauges have been collected together into one mobile unit. Oil at high pressure is supplied through flexible tubes to the control unit, where it is metered and reduced in pressure and distributed through a further set of flexible tubes to the six jacks inserted between the test frame and the specimen.

Although the hydraulic jacks will be used in most experimental work, loads can also be applied by deadweights or by air bags acting between the specimen and the reaction framework. For strain measurement on test specimens it is intended to use electrical resistance methods, acoustic gauges and mechanical dial gauge strain indicators. The testing apparatus was designed by the staff of the Structures Research Section of the Association.

Research Work

The first work to be undertaken in the new laboratory will consist of experiments on interconnected concrete beams, prestressed longitudinally and transversely, the aim being to compare the performance of the structure in the elastic range with the predictions of theory, and to observe the form of the redistribution of load amongst the beams after cracking. The structure consists of four main (longitudinal) beams, spanning 20ft, each prestressed by the Magnel system and spaced at 21in centres. Between these beams, at the quarter, half and three-quarter points of the main beams, are the transverse beams, which are prestressed by the Lee-McCall system. The load is applied at points equidistant from the centre of the span and may be applied on one or more of the beams.

Deflection of the structure is measured at thirty-six points by vernier deflection gauges devised by the Association staff. These can be read to 1/100in and are suspended from a tubular scaffolding reference frame built round the structure. Strain is recorded at 174 points; at fifty by electric resistance strain gauges, and at the remainder by a mechanical strain gauge. Finally, the twist of the beams relative to one another is measured at thirteen points by another mechanical gauge.

It is intended also to carry out similar tests on longitudinally continuous prestressed beams, in addition to studying their performance near the point of failure. Other researches include experimental work on shell roofs, which will take the form of testing to destruction a number of model test specimens of about one-fifth full size, with particular reference to the effects of longitudinal continuity. In co-operation with the City and Guilds College (University of London) work is being carried out in the laboratory on the redistribution of stress in reinforced concrete redundant frames after plastic hinges have been formed.

All-Basic Open Hearth Furnaces*

No. II—*(Continued from page 648, May 18th)*

Last week's article outlined the papers presented at a conference at Leamington Spa on May 2nd and 3rd. The following is a summary of the discussion.

Discussion

Mr. P. W. A. Lanzing, of the Royal Netherlands Blast-furnaces and Steelworks, spoke about experiences on No. 5 furnace at Ijmuiden.

The roof had been built of chrome-magnesite bricks, but the uptakes partly of chrome magnesite and partly of magnesite chrome. It had been possible to carry out comparisons on liability to bursting, and it had been found that the chrome-magnesite bricks had given the worst results, magnesite-chrome bricks made with sea-water magnesia a medium result, and magnesite-chrome bricks made with Austrian magnesite had given the best results. The bricks which behaved best in the furnace had the lowest bursting expansion indices as determined in the laboratory, but the worst refractoriness-under-load value.

Little trouble had been experienced with the roof which had been cooled down five times during the course of the first campaign, and he could say that they were satisfied with it. During the first campaign there had at first been little longitudinal expansion, but after 250 to 300 heats the whole roof showed expansion comparable with the crosswise expansion, which amounted to about 6in. During the second campaign no trouble had been experienced owing to expansion up to 240 heats, though the expansion of 3 per cent allowed would appear to be too much.

It had been thought that the uptakes in the first campaign were too small, but they had been repeated in the second campaign and were still considered a benefit rather than a limitation.

The slag pockets were basic lined and they had found deposits easy to remove after 250 heats in the first campaign, but more difficulty was experienced in the second after an increase in fuel input.

Mr. Lanzing felt that the furnace had justified itself economically. In the first campaign there had been an increase of 10 per cent in the output over thirty-three weeks. In the second campaign this increased output had been maintained until after 300 heats and had then dropped, but had been regained by a higher fuel input or by better fuel atomisation. It was difficult to decide which had been responsible.

He felt that in all-basic furnaces there was a "break-even point" in roof life beyond which an all-basic furnace would show economic advantage over a silica counterpart. At Ijmuiden they were averaging ninety heats on comparable silica furnaces, and he considered that 400 heats would provide a break-even point for their all-basic. This they had exceeded.

Mr. E. Voet, also from the Royal Netherlands Blast-furnaces and Steelworks, did not think that the uptakes were necessarily too small on their furnaces. In the second furnace now built the same kind of uptake was being used and an output of 19 tons per hour on quite a reasonable fuel consumption was being achieved. He thought this indicated that the uptakes were the right size. He agreed that if they were larger, they might be easier to maintain.

Mr. A. I. Aitken, of Colvilles, Ltd., entitled his contribution to the discussion "The Cons of the All-Basic Furnace." He said he understood the productivity potential of an all-basic furnace, but was adopting a "sitting-on-the-fencive" attitude to its introduction as an economic unit.

It was the steelmaker's chief aim to keep his furnace in full production from holiday period to holiday period, with a minimum of running repairs. Checkers, by suitable design and construction, could already be made to perform efficiently for two roof campaigns or from holiday to holiday. If they lasted longer than twenty-five weeks, even with blowing at regular intervals, they might be said to have been operating under par. Moreover, a constant high preheat meant fairly early checker replacement. Recent advances in silica roof brick quality gave promise of a silica roof also lasting twenty-five weeks. If one could achieve three times the number of heats, as compared with silica, the basic roof would prove a paying proposition. In such case two holiday periods would be bound to intervene. How adversely would such an hiatus affect the basic roof—both on cooling down and subsequent reheating?

Mr. Aitken questioned whether the all-basic furnace was a sound proposition with standard producer gas firing practice, with its normal week-end shut-down for burning out gas mains, &c., except in those few plants with a modern producer and gas tube system using auxiliary burners.

With their producer-gas-fired 90-ton to 100-ton Venturi furnaces his works was producing at the rate of 9½ to 10 tons per hour on cold pig iron/scrap process. They only attained their safe working limit of 1650 deg. Cent. roof temperature with one to one and a half hours of the refining process to be completed. Where suitable automatic control from roof temperatures was installed with a silica roof, just what gain in productivity would result from all-basic construction? And how many melting shop managers would like to see any reduction in their refining time to under one hour?

On the steelmaking side higher operating temperatures might cause an increased solubility of hydrogen and nitrogen; more fluid slags, which not every melting shop manager would welcome; possibly increased bottom solution, though he admitted that all-basic construction made it possible to burn in a magnesia bottom, and possible inversion of phosphorus from the slag to the steel. Sulphur removal, where necessary, was, like phosphorus removal, dependent on low temperature and the solution effect of slag bulk. Mr. Aitken claimed that steel which had been cooled from an excessive temperature to the tapping temperature had not such good quality as steel whose temperature rose to, and did not exceed, the optimum. Then, too, charging facilities had to be more than adequate. He felt that the primary trials had been carried out on ill-designed furnaces. Of the six trials the only one showing foresight

* Communicated by British Iron and Steel Research Association.

was that at Ijmuiden, and only something radically different both in design of furnace from the combustion angle and in the method of applying the bricks to the roof would give results to convert him. Possibly, a modified Ijmuiden furnace with a Pluck suspension might be satisfactory.

The Chairman mentioned that there was an all-basic furnace at Guest Keen Baldwins works, which had so far operated for twenty-two weeks, giving 400 heats. They calculated that their break-even point would be at 450 heats. So far the furnace had been reasonably satisfactory.

He asked first if it would not be possible to overcome iron oxide absorption and bursting by inducing some sort of glaze on the face of the bricks. Second, might it contribute to solution of slag pocket difficulties if deposits were removed more often, before they had sintered hard ?

Dr. Rigby said that such a glaze might be possible. Bursting expansion could be cut down at the cost of other properties and the essential was to define from experience the precise properties wanted.

On the removal of slag from the pockets at an earlier stage, Mr. D. Craig (Steel, Peech and Tozer) said that this had been done mechanically in the U.S.A., but the repeated cooling had contributed to a short roof life. Mr. J. Mitton mentioned that at Bilston interruption of the campaign had been postponed for three weeks by removing the crown of the deposit, but it had been necessary to use crowbars to get it out. Mr. J. Adams of the Lancashire Steel Corporation said they had removed the slag without trouble in 1937 through a wicket after six weeks and every subsequent two weeks. Mr. H. Parnham (General Refractories, Ltd.) suggested that the steel industry might use boiler technique. A plastic chrome lining to the slag pocket should make it possible to slag the deposits out with silica and tap them off. Mr. G. H. Timmins (Stewarts and Lloyds, Ltd.) commented that at Bilston, in 1938, the slag pockets had never filled, as the deposits settled to the bottom; now they set solid and built up. Dr. Chesters suggested that the agglomerated mass that formed the deposits might be critical as regards its melting point, even a short period of high temperature giving a marked solidification. Dr. Rigby thought that the alteration at Bilston from gas to oil fuel might have contributed to the change in the nature of the deposits.

Mr. R. A. M. Wright said that he had been successful in stopping excessive wear in a silica roof by inserting a strip of chrome-magnesite bricks above the taphole, where it was taking place. Dr. Chesters referred to the "Zebra" roof, now widely used in America, which consisted of crosswise basic inserts at either side of the furnace. He had seen inserts of this sort standing 2in or 3in proud of the adjacent silica bricks. It certainly increased the life to the first patch, though not the melting rate. There was no suspension. He had no data on the economics of the device.

He hesitated to disagree with Mr. Aitken on metallurgical matters, but despite the higher roof temperature of the furnace, he did not think the quality of the steel need be affected. Steel temperature could be controlled by use of the immersion pyrometer and fast melting did not mean hotter steel.

Mr. Lanzing and Mr. Mitton, who operated regularly at 1680 deg. Cent., agreed. They had no metallurgical troubles with their all-basic furnace that they did not have with silica roof furnaces. Dr. T. P. Colclough (British Iron and Steel Federation) said that with a well-designed silica roof furnace bath temperatures were achieved that necessitated shutting off the fuel half-an-hour before tapping. A high temperature could not affect phosphorus removal, but it might cause ingot cracking. Mr. Timmins agreed. At Bilston they were casting round ingots, and steel temperature was controlled by immersion pyrometers and automatic roof temperature control. Mr. C. W. J. Crawford (British Iron and Steel Research Association) added that it was desirable to get a high steel temperature early on to start off the chemical processes. Mr. S. R. Isaac (Richard Thomas and Baldwins Ltd.) said that slag took more melting than scrap and would show more advantage to a basic roof, which could increase the speed of a furnace but would not necessarily raise steel temperature.

In reply to a question by Mr. Voet, who said that the present fuel input at Ijmuiden was 530 gallons per hour, Dr. Chesters said that there was an economic limit for every design of furnace and fuel burning arrangement to the possible rate of fuel input. It could, however, be raised by improved furnace design or more refractory materials. He emphasised the necessity for roof pyrometers in this connection.

Dr. A. H. Leckie (British Iron and Steel Research Association) reverted to the question of uptake size. He thought the correct size for the volume (and temperature) of waste gases or air required could be calculated, and such calculation might often show that they could be smaller than they were in practice.

High fuel consumption, he thought, would be corrected as more experience was gained, as it should be possible to run an all-basic furnace with less excess air than was usually found necessary when "driving" a silica furnace. He emphasised the desirability of full instrumentation if the benefits of higher roof temperatures were to be obtained. At Bilston, for example, automatic roof temperature-control had contributed to the excellent results.

Mr. A. McKendrick (Glenboig Union Fireclay Company, Ltd.), speaking as a maker of refractories, said that all manufacturers in the United Kingdom were making efforts to improve basic refractories with such raw materials as were available. Steelmakers should not be discouraged by early failures when they tried basic roofs. Unpredictable things happened even with silica roofs. He urged Scottish steelmakers to build one furnace at least, rather than confine themselves to criticism.

The discussion ended with a warm tribute by Dr. Chesters to the representatives from Holland, whose full and friendly co-operation had contributed so much to the success of the conference.

There were 147 delegates, including three from Holland.

The Gauge and Tool Exhibition

No. II—(*Continued from page 649, May 18th*)

WE conclude below our description of some of the equipment shown at the third Gauge and Tool Exhibition, at the New Horticultural Hall, Westminster, S.W.1. The exhibition closes to-day, May 25th.

Redman Tools and Products, Ltd.

During the past few years the "Unipierce" and "Unicrop" units developed by Redman Tools and Products, Ltd., of Worcester, have been used in increasing numbers in industry to reduce tooling costs. These tools consist essentially of a rigid cast U-shaped body with a deep throat, having a hardened anvil carrying a die on one of the arms, and a corresponding spring-loaded punch mounted in the opposite arm. The units can be mounted in all types of presses or press brakes and can be used singly or in groups for piercing and cropping round or irregular shaped holes and notches. In groups they can be used for compound operations, such as piercing and dishing, piercing and countersinking, piercing and extruding, and for multiple piercing and notching on metal, asbestos, plastic sheets, channels and angles.

Round and shaped holes up to 2¼in diameter can be pierced with the "Unipierce" units, and corners, side notches and forms can be cropped up to 3¼in square with the "Unicrop" units. As the units are self-contained and not attached to the top ram of a press, their interchangeable punches and dies are positively aligned at all times.

A typical press application is shown in the accompanying illustration (Fig. 7) by courtesy of James H. Randall and Son, Ltd. By the transfer method adopted the component of sheet metal is notched at the first station and then passed to the second station, where the holes are pierced, both operations being performed at one blow of the press.

The units are located by a template let into the bolster, which has holes in it to correspond to the centres in the component. A dowel underneath each unit, central to punch and die, locates the unit in the holes to the template. This method gives quick, simple and accurate setting and the template can be stored for future use or drilled again to locate the same units in as many different combinations as required.

FIG. 7—PRESS UNITS—REDMAN

Other equipment shown on the stand includes press brake forming tools, press tools and special-purpose hydraulic-operated machines.

Clarkson (Engineers), Ltd.

A new chuck designed for use with milling cutters from 2in. to 6in. diameter is being shown by Clarkson (Engineers), Ltd., of Nuneaton. This unit is known as the "Dedlock," and has been developed to extend the range of the firm's "Autolock" chucks which take cutters from ⅛in to 1¼in diameter.

The simple construction of the chuck and

the way in which it rigidly holds milling cutters can be seen in Fig. 8. The shank of the chuck is made integral with the body and can be supplied to fit all standard tapered bores. It can be used only with the firm's design of milling cutters which are counterbored and screwed at one end as shown. A plug *A*, which is a close sliding fit in the bore of the body, has at its outer end a screwed spigot *B*. The cutter is fitted to the chuck by simply screwing it up the spigot until its innermost face contacts the body of the chuck. The tool, whilst it is cutting, is automatically tightened on to the chuck in proportion to its loading. When it

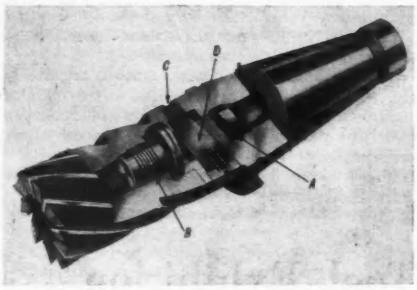


FIG. 8—THE "DEDLOCK" CHUCK—CLARKSON

is required to remove the cutter the socket-headed screw *C* is screwed down into the body of the chuck, and it pushes the spring-loaded tapered wedge *D* back. This movement of the wedge piece releases the plug, which can drop down towards the cutter for its spigot to release the grip between the cutter face and the body of the chuck. The cutter can then be easily unscrewed and removed. Before another cutter is screwed on the chuck the wedge screw is turned back to its original position.

It will be appreciated that with this design none of the load imparted when driving the milling cutter is transmitted through the wedge.

Together with the chucks, there are shown on this stand numerous examples of the different cutters made by the firm.

THOMAS MERCER, LTD.

A recent addition to the measuring equipment made by Thomas Mercer, Ltd., of St. Albans, is an air-operated gauging unit, known as the "Pneugauge." The model exhibited is designed

FIG. 9—PNEUMATIC GAUGING UNIT—MERCER

for measuring bores down to $\frac{1}{16}$in diameter, but the makers say that members are being developed for the checking of external diameters and thicknesses.

The gauge, illustrated in Fig. 9, is designed to operate on a supply of compressed air at any pressure between 60 lb and 150 lb per square inch. Readings are taken from a 6in diameter gauge set at an angle in the case of the instrument. The measuring range, which varies in accordance with the type of scale, can be from 0·001in for increments of 0·00005in, or 0·003in when graduated in 0·0001in. The gauge scale is marked plus and minus either side of zero and red tolerance pointers are fitted to the glass cover.

In this unit the gauging mandrel of the required size is mounted on the lower part of the front of the case by means of a quick-action adapter. If it is required to check work mounted on a machine a length of flexible air hose is interposed between the unit and the gauging member. Connection to the main air supply is effected through a nipple on the left-hand side of the instrument, and on the right-hand side are the knob for effecting zero adjustment and a pressure gauge showing the constant air pressure at the control orifice. Air entering the instrument passes through an air cleaner and filter fitted inside the case. A drain connection, fitted to the bottom of the filter, leads to an external drain and is controlled by a knob on the left-hand side of the case.

From the cleaner the air passes to a sensitive reducing valve, which holds the pressure at the control orifice at the set figure, regardless of changes in supply pressure or in the rate of flow. From the reducing valve the air passes to the control orifice and thence to the gauging member, indicating gauge and zero adjustment. The control orifice is easily accessible for inspection or replacement by unscrewing a knurled plug on the right-hand side of the case.

There is also exhibited a range of some 300 gauges, including the "Unitest" universal dial indicator specially developed to combine high sensitivity with repetitive action. This fully jewelled instrument has a 1in dial graduated in 0·0001in or 0·005mm, and its body is fitted with dovetail slides and a universal clamp.

OPTICAL MEASURING TOOLS, LTD.

Much of the equipment made by Optical Measuring Tools, Ltd., of Slough, has already been described in these columns, and that on the firm's stand, although incorporating certain improvements, is generally familiar.

The exhibits include the "O.M.T." toolmaker's microscope, which can be used for the inspection of form tools, plate and template gauges, punches, dies, grooved or threaded hobs, screwed components and the general inspection of all intricate shapes within its capacity. The table has a longitudinal movement of 6in and transverse travel of 2in, both controlled by graduated micrometers for 1in, slip gauges being used to build up to the full capacity. A protractor ocular and template oculars to suit all kinds of thread form can be supplied, and magnifications of 10, 30, 60 or 100 times can be obtained.

Also shown are rotary and inclinable tables with diameters of 12in or 16in. In both sizes the table has a circular movement of 360 deg. and is inclinable from 0 deg. to 90 deg. Angular positions on both the rotary and inclinable scales are observed through separate eyepieces to direct readings of 30 sec of arc, or to 6 sec by estimation.

Another interesting product of this company is the projection "Pantometer," which has been designed specially for the rapid inspection of three-dimensional contours, such as the blades used in jet turbine engines. With its optical system a magnification of 30× is obtained with a screen of 6in diameter.

The latest addition to the measuring equipment produced by the firm is the surface projector we illustrate in Fig. 10. It is designed for the projection and measurement of surface contours, such as type faces, matrix punches, &c., involving fine dimensions, and where form control is essential.

To cover a large range of magnifications which may be required on some classes of work a means of infinitely variable magnification has been incorporated in this instrument and it covers a range of 30× to 180×. This range is divided into five parts by the use of five lens

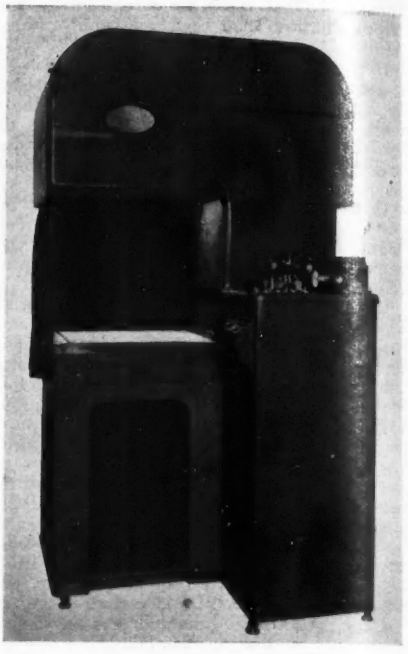


FIG. 10—SURFACE PROJECTOR—O.M.T.

systems mounted on a rotating accurately locating turret. Each lens covers part of the magnification range. Any value of magnification within the range of the lens system being used can be selected through a push-button control which operates an electric mechanism for changing the position of a mirror system within the projector, thereby altering the optical pitch length to decrease or increase the magnification.

The panel on which the controls are conveniently grouped for ease of operation incorporates a window through which five engraved drums are observed, each drum being connected to its appropriate lens, and marked with a magnification scale. When the push-button control is operated the drums slowly revolve, enabling any desired magnification to be selected.

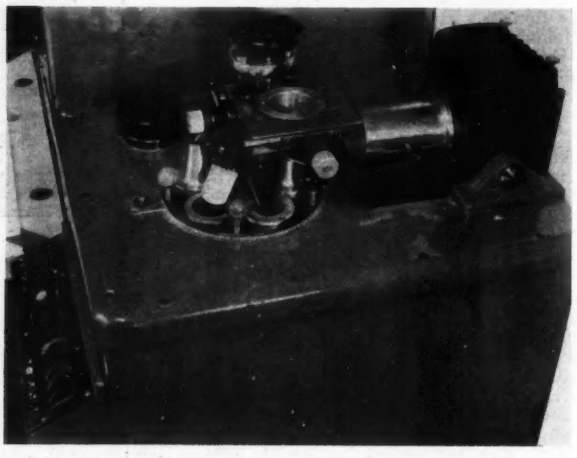


FIG. 11—SURFACE PROJECTOR TURRET—O.M.T.

Brilliant illumination is provided at all

magnifications by the lighting unit and condenser system which are built to require the minimum of manual adjustment.

The work stage includes a fine focusing control and co-ordinate movements for the rapid alignment of the work image with the screen drawing, and the plate of the work stage is designed to accept suitable fixtures for mounting workpieces. The opaque screen is set at a convenient height for comfortable observation and with it drawings made on metal can be used to avoid the dimensional changes which can occur with paper and plastic materials used with translucent screens. The effective screen area is 24in square.

Solex (Gauges), Ltd.

Several forms of its wide range of pneumatic gauging equipment are to be seen upon the stand of Solex (Gauges), Ltd., of 223, Marylebone Road, London, N.W.1. One of two extensometers now being made by the firm gives 200,000 magnifications on a base length of 2mm, the other having a similar range on a base length which is adjustable from 25mm to 60mm. The firm is demonstrating also a range of standard parts which can be rapidly assembled to form uni- versal comparators for a variety of dimensional checking work.

For checking the movements and positions of slides and tools on machine tools whilst they are in operation this company has now introduced a new range of feed gauges.

Pitter Gauge and Precision Tool Company, Ltd.

A direct measuring interferometer made to N.P.L. design by the Pitter Gauge and Precision Tool Company, Ltd., of 23, Market Street,

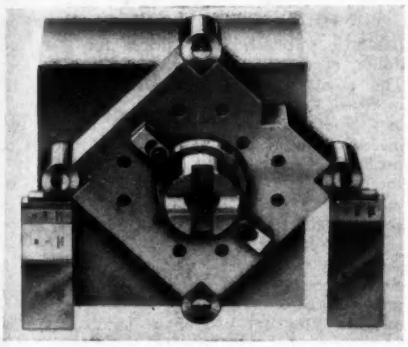


Fig. 12—Combination Sine Square—Pitter

London, S.E.18, is exhibited amongst the equipment on that firm's stand. With this instrument, which has a direct reading capacity from 0in to 2in, direct measurements to one millionth of an inch can be obtained.

The equipment shown for workshop or inspection department use, which is made by

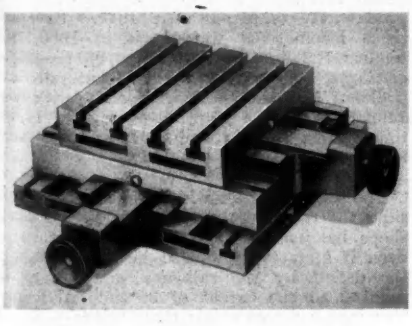


Fig. 13—Co-ordinate Table—Pitter

this firm, is generally familiar, but two new units are a combination sine square (Fig. 12) and a co-ordinate table (Fig. 13). In this sine square, 1in diameter precision rollers are mounted at each corner and a 1in central bore is provided. It has a wide range of uses in machining or measuring angles from 0 deg. to 360 deg., indexing, checking of dividing heads, squareness, testing, &c.

The co-ordinate table can be used for accurate drilling, mounting on a face plate or inspection purposes. It consists of two tee-slotted tables mounted on a base and having a traverse of 5in in two directions accurately at 90 deg. With the use of slip gauges the tables can be set to extreme accuracy and locked independently. This unit has a working surface 7½in square.

In addition to the precision measuring and manufacturing equipment the firm is showing some selected examples of the tools, jigs and fixtures it has made to special requirements.

Cabul Tool Company, Ltd.

The way in which the "Penetrascope" portable hardness tester can be used in places difficult of access can be seen in Fig. 14. This instrument, which is made by the Cabul Tool Company, Ltd., 46/48, Battersea Bridge Road, London, S.W.11, was developed to provide an accurate and portable machine working on the 136 deg. diamond indenter principle. In it the indenter is operated by a hydraulic thrust unit and the load can be quickly and

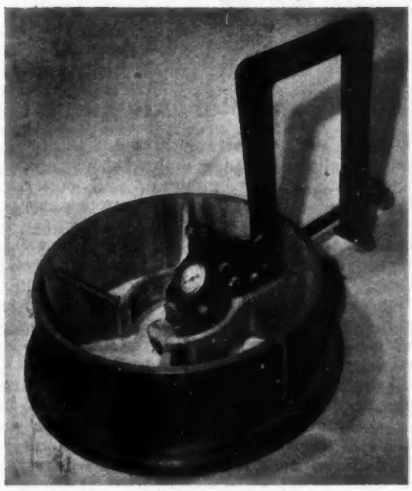


Fig. 14—"Penetrascope" Hardness Tester in Use—Cabul

easily varied by turning a small handwheel. The indentation made in the metal by the diamond is viewed through an illuminated microscope and the width across the diagonals of the indentation is measured on a micrometer counter as a decimal of a millimetre. The measurement is converted to diamond pyramid hardness numbers by using British Standard Tables No. 427 : 1923.

A maximum load of 30kg is applied and just before it is reached a red pilot light is switched on by turning the application handwheel. The hydraulic thrust unit consists of four main parts—a Bourdon tube pressure gauge, a flexible metal bellows, a thrust spindle, and a load screw. The bellows are connected to the pressure gauge by a copper tube filled with a special fluid, the system being calibrated with dead weights before being hermetically sealed. When the load is applied through the handwheel pressure is applied direct to the diamond indenter through the bellows and thrust spindle. This pressure causes the bellows to close and transfer the fluid to the pressure gauge.

After the indentation has been made and the load released, a turret on which the diamond unit is mounted is rotated and the microscope viewing head aligned with the indent for the reading to be taken.

Coventry Gauge and Tool Company, Ltd.

An extensive display of high-precision gauging and measuring equipment has been selected for exhibition by the Coventry Gauge and Tool Company, Ltd., of Coventry.

A taper diameter measuring machine on the stand is designed to measure tapers to within 0·0001in. On it readings are taken on a micrometer used in conjunction with a fiducia indicator, at various points along the taper, the exact distance between the points being set by slip gauges. The firm shows also its measuring machine for internal plain and threaded bore diameters from ½in to 6in and up to 2in deep. This machine is stated to be accurate to within 0·00005in on diameters and 0·0001in on pitches. In addition to other measuring equipment, dividing heads, and "Micro-Maag" internal micrometers, there are also shown sets of combination length bars, slip gauges and accessories, a comparator for three-flute taps, and a drill point measuring machine.

Examples of the tool-making side of the firm's activities are demonstrated by a selection of broaches, jigs, press tools and fixtures.

M.P.J. Gauge and Tool Company, Ltd.

Several types of dial gauge equipment are made by the M.P.J. Gauge and Tool Company, Ltd., of Erdington, Birmingham, for the continuous measurement of bores and outside diameters during grinding. The exhibits of the firm include new dial caliper equipment, which increases the range of application to throat depths of up to 2ft.

Amongst a recently introduced range of tube wall thickness gauges displayed is that illustrated in Fig. 15 for use with

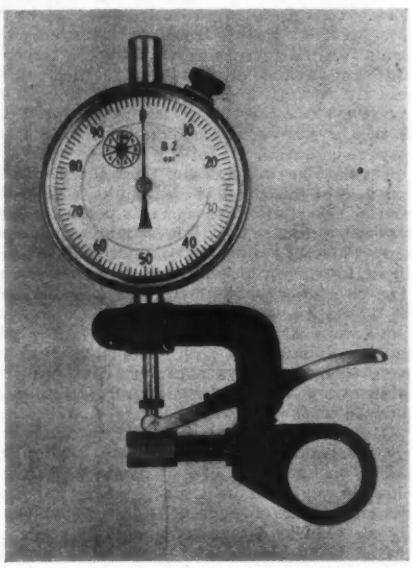


Fig. 15—Tube Wall Gauge—M.P.J.

tubes of ⅜in to 3½in bore and with walls up to ⅜in thick. The new unit is provided with eight interchangeable anvils to cover the range of tubes. The smallest anvil has a radius of $\frac{3}{16}$in and the largest 1½in. Anvils are chosen to suit the internal dimension of the tube being measured—for instance, when measuring a tube with a 3in bore the largest anvil would be used. For proportionately smaller bores smaller anvils would be fitted. The spindle of the dial gauge is actuated by a heavily spring-loaded, thumb-operated lever, which, when released, accurately locates the anvil in the bore of the tube.

The instrument can be fitted with dial indicators reading 0·001in, 0·0005in, 0·0001in, or 0·1mm or 0·2mm.

Electricity Corporation of Nigeria.—The Electricity Corporation of Nigeria has announced that all Nigerian Government electricity undertakings were transferred to it on April 1st. Plans are now in hand for extensive development schemes with the ultimate intention of providing a modern electricity network for supplying all provinces in Nigeria. Mr. J. Houston Angus is chairman of the Corporation and Mr. H. Batty is acting chief engineer. Mr. E. C. Inston is in charge of the Corporation's London office at The Corner House, Great Peter Street, S.W.1.

River Wyre Cable Crossing

An important cable installation for the North-Western Electricity Board was recently completed by British Insulated Callender's Cables, Ltd., when two 33kV three-core cables and an auxiliary cable were laid across a 1050-yard stretch of the Wyre Estuary at Fleetwood. These cables are for connection to an existing 6·6kV supply on the generating station site at Fleetwood and, on the Preesal bank, to an overhead line, which is also being constructed by the same organisation. The voltage will eventually be stepped up to 33kV when the Fleetwood power station is completed and the electricity supply will then be sufficiently boosted to cater for heavy loads in the Preesal neighbourhood of the important Fylde district of Lancashire.

Two 33kV, three-core, 0·30 square inch, paper insulated, lead-alloy sheathed, single-wire armoured cables were installed, together with one ten-pair telephone and single-core 1·036 square inch vulcanised rubber insulated lead-alloy sheathed, single-wire armoured auxiliary cable.

To avoid underwater joints the two power cables were manufactured at the B.I.C.C. Erith works, in single 1130-yard lengths, which necessitated the construction of two exceptionally large cable drums. These drums, the largest ever built, are 12ft in diameter by 8ft wide and, complete with cable, each weighed 36 tons. Their transit by road from the works to site involved special transport arrangements, using two diesel lorries with eight-wheel trailers. One drum was mounted laterally on each trailer and the lorries travelled in convoy with police motor-cycle escort at a maximum speed of 5 m.p.h.—the 250-mile journey taking four days to complete.

On the Fleetwood side of the estuary a wide expanse of muddy flats and banks is exposed at low tide; at the spring tide periods, when the water recedes to its lowest limit, a channel only 100 yards wide remains near the Preesal bank, in which the river itself flows to the sea. The two power cables were laid at a distance of 50ft apart, with the pilot cable alongside the downstream power cable. Across the 100-yard stretch of the river channel the cables were to be laid at a minimum depth of 1ft, while over the remainder of the estuary crossing a depth of 3ft was specified.

The blasting of the trenches in the hard clay river bed was one of the first operations undertaken on the site. Polar Ammon gelignite charges were laid in a string along the predetermined line of the trench and were exploded by an electric detonator, about 50 yards of trench being blasted at a time. The charges were of the plaster type, being laid on the river bed and not embedded in it, and were fired when there was sufficient depth of water over them. Soundings were then made to ascertain that the blasting had been effective.

Meanwhile, trenches had been excavated on the Preesal side of the river and, at the shore end of these, two winches installed. The wire bond for pulling the first cable was subsequently hauled across and attached to the upstream winch. The usual method of laying submarine cables by employing a cable-laying barge was impracticable due to the difficult tides and the cables were therefore pulled across by winches on the Preesal side, from which wire bonds were run across the estuary for attachment to the leading ends of the cables.

It was initially decided to pull the cables, floated across the water on oil drums, during a neap tide period, and thereby take advantage of slacker water. During a neap tide period more than half of the estuary is flooded —even at low water—but not to an extent which allowed the cable to be floated. To take advantage of the neap tide slack water, therefore, it was necessary to pull the cable at high water. About 250 yards of the first cable was pulled out towards the water's edge on March 15th and, on the following day, at 2 p.m.—approximately three hours before high tide, the pulling operation across the water was begun.

The oil-drum floats were attached to the cable at 9ft intervals as it was hauled from the bank at the Fleetwood side and, at 5.30 p.m., the cable was landed successfully on the far bank. The floats were removed as the cable grounded and the cable was finally made off by the winch at 6 p.m. Due to the short period of slack water, it was not possible to leave the cable right on line and it was moved to the correct position in subsequent operations. Across the mud flats cover was provided by digging out progressive lengths of trenches and back-filling the soil over the cable during periods of low tide. This lining up and bedding-in of the cable, scheduled for completion before the next neap tide, was adversely affected by weather conditions: the succeeding days brought heavy rainstorms (as much as 1in of rainfall during one fourteen-hour period) and severe gales with wind speeds of up to 80 m.p.h. Consequently it was not possible to begin the second cable-laying operation as planned and it was agreed to pull the cable across the estuary on rollers at low tide during the spring tide period. This operation was successfully accomplished in three hours on April 4th, the cable being moved across at a speed of approximately 20ft per minute. The auxiliary cable was similarly installed on April 6th.

A Century of Aluminium

The present-day structural uses of aluminium and its alloys are adequately demonstrated at the South Bank Exhibition, and historical review of the growth in importance of the metal during the last hundred years can be seen at the offices of the Aluminium Development Association, 33, Grosvenor Street, London, W.1. This small and compact exhibition illustrates, within a narrow compass, the complete change-over from being a chemical curiosity in 1851 to the present status of a metal of primary importance in practically all fields of industry. The exhibits indicate that the metal, which was first produced in 1825 by a Danish chemist, Hans Christian Oersted, was used as a precious metal for such items as medallions, while to-day, in strong contrast, it is available as ships' constructional plates of large size.

H. St. Claire Deville produced aluminium on a small scale in 1855, and a medallion struck at the time, together with a copy of Deville's book, "L'Aluminium" (1859) are on show. The effect of the electrolytic process, discovered in 1886 simultaneously in both France and America by Paul Héroult and Charles Martin Hall, respectively, upon the price of aluminium is recorded. By 1894 the price had fallen from £20 per pound to 1s. 8d. per pound which marked the real beginning of the industrial expansion. The metal was strengthened by alloying it with other elements, and an age-hardening alloy was discovered early in the century. An example of this high-strength alloy is seen in the form of part of an aircraft strut (1916), and there is one of the first aircraft propellers formed by shaping a piece of rolled metal. The use of aluminium in the automobile industry is exemplified in the cast crankcase used for Standard cars during 1922 to 1925, and a 1950 production model of a French Panhard-Dyna car, which is built up of aluminium alloy castings and panels. Plans for a light metal mineral wagon indicate possible developments in railway transport, and examples of thick plates, as used to-day in the shipyards, show the progress made since Yarrow and Co., Ltd., built the hull of a French gunboat in 1894.

Stabilisers on Cross-Channel Vessel.—To overcome the effect of the strong cross currents in the Irish Sea and to improve the comfort of the passengers, British Railways (London Midland Region) arranged for the cross-channel motor vessel "Cambria" to be equipped with Denny-Brown stabilisers. The vessel is now in service and it is anticipated that the roll will be limited to not more than 3 deg. A sister vessel, the "Hibernia," is also to be equipped with stabilising gear before the beginning of the summer season.

French Engineering News

(From our French Correspondent)

A new and important chemical plant is to be built with Marshall Aid funds near Marseilles. A grant of 850,000 dollars has been made for the purpose. The plant will employ 500 workers and will be the first in France to produce organic chemicals from petroleum. It will come into operation in 1952.

* * *

Shortage of sheet steel is holding up shipbuilding in the North of France. The Dunkerque shipyards have announced that work on some construction has had to be stopped. Other work has continued by using sheet steel destined for other constructions.

* * *

The Alsthom Company has built a 135kW radio transmitter for the Yugoslav Government. It is to be erected at Ljubljana, will broadcast on 327m (917 kc), and will be part of a ring of similar transmitters erected or planned for Skoplje, Titograd, Sarajevo, Belgrade, &c.

* * *

The French Standard Oil Company has opened a new laboratory at Port Jerome. It is the last step in the vast reconstruction plan for Port Jerome which was almost completely destroyed during the war. The laboratory will not only check and control production, but will also undertake research work. The new refineries have an output capacity of about 1,928,500 tons per annum. A new Port Jerome-Le Havre pipe-line has also come into operation. It will be capable of transmitting 4 million tons per year as soon as a second pumping station is completed.

* * *

The *Official Bulletin of the Price Services* has just published new prices for steel products, representing increases of 18 per cent. The steel industry is dissatisfied with the increase, and has pointed out that an inquiry last November revealed that a 30 per cent increase would still not give a margin for profits or payments to shareholders. It is thought that the increase will just enable the industry to cover its running costs, without any margin for amortisation, so that France will be in an unfavourable position in the coal-steel pool. The new decree which fixes the steel prices also authorises cast iron producers, under certain conditions, to determine their own prices for some products. They are required to inform the price control authority fifteen days before new price scales are brought into force. Despite dissatisfaction with the increase, the long delay in giving the decision has now ended and it will again be possible to resume normal business. Some steel plants had been refusing to take orders, awaiting the announcement of the higher prices.

* * *

Figures for rolling stock construction in 1950, by French manufacturers, have just been issued and show a drop in average monthly production compared with 1949. Seventy-three locomotives were built in 1950, 105 tenders, 122 shunting locomotives, 281 passenger carriages, 10,376 trucks, and 85 autorails and trailers. The total tonnage for the year was 149,200 tons, or a monthly average of 12,433 tons against 14,256 tons in 1949 and 5975 tons in 1948.

* * *

The sub-committee which was set up to consider the reorganisation of the S.N.C.F. workshops, has just issued its report. It states that even if all activity ceased in the workshops the deficit by the railways would only be reduced to the extent of 30 milliard francs. The report recommends that, where possible, the rolling stock workshops should be separated from the repair shops; the former would then be managed by limited companies dependent on the Syndicat général des Industries mécaniques and not by the S.N.C.F. The new companies would establish agreements with the S.N.C.F., similar to those now ruling in other industries. The report states that a transitional period would be needed to carry out these measures.

Industrial and Labour Notes

Economic Survey of Europe

THE United Nations Economic Commission for Europe has published an economic survey covering the year 1950, and dealing with such matters as the expansion of production, the shortage of basic materials, and international trade and payments. It says that the fifth post-war year was one of continued, and in some respects unexpected, progress in European production. For the area as a whole, industrial output last year was 13 per cent greater than in 1949, largely owing to a continued rise in productivity. Total agricultural production in Europe also increased last year, but, as in the other post-war years, the expansion was not commensurate with that in industrial production. Investment activity was maintained at a high level, and most European countries, the survey states, continued to devote a much greater share of their total resources to the further expansion of their productive capacities than before the war.

Dealing with production in various industries, the survey says that between 1938 and 1950 total industrial output in sixteen eastern and western European countries rose by nearly one-quarter, with engineering output increasing by well over one-third. The chemical industries also continued to expand at a rate well above the average in all European countries. But mention is made of the fact that the output of other basic materials, such as coal and iron ore, continued to lag behind industrial production. One chapter of the survey is devoted to the shortage of basic materials, it being stressed that the most serious shortages in Europe this year are likely to be coal, steel and, in the United Kingdom, sulphur. Although coal enters universally into all production, the survey comments, its increased output in the United Kingdom and Western Germany this year will still leave production well below the pre-war volume. Even with imports from outside sources, coal consumption in Western Europe in 1951, it is suggested, could hardly rise by more than 5 per cent over last year. Furthermore, the survey continues, whatever limits coal supplies may impose on general European production, it seems quite certain that the output of steel, owing to a shortage of iron ore and scrap, will be insufficient to allow either the steel industry or the wide range of metal-using industries to contribute their full quota to the 13 per cent expansion of industrial production estimated earlier to be possible with adequate supplies of raw materials. Meanwhile, it is added, the increase in world supplies of all the non-ferrous metals except aluminium will almost certainly be modest compared with the potential demand.

In general, the survey concludes, it is unlikely that large-scale unemployment will develop in Europe as a result of the material shortages, it being "one of the characteristics of an inflationary situation that employers hold on to labour for which they currently have no use for fear that it will no longer be available when the shortages disappear." The cost, the survey asserts, is passed on to the consumer, and productivity is likely to rise much less than would be technically possible.

Employment and Unemployment

According to statistics issued by the Ministry of Labour, the total working population of Great Britain at the end of March was 23,225,000 which was 11,000 more than at the end of February. The increase during March was accounted for solely by an addition to the number of women at work in industry. In civil employment at the end of March there were 22,149,000 people (14,954,000 men and 7,195,000 women). Of that number 4,105,000 were occupied in the country's basic industries, the only addition in that group being 2000 in coal mining. The number of wage earners on colliery books at the end of March was 703,000, compared with 689,000 at the end of December last. The manufacturing industries added 8000 to their manpower total during March, bringing the figure by the end of the month to 8,678,000. The "metals, engineering and vehicles" group was employing 4,117,000 people by the end of March, compared with 4,086,000 at the end of last year.

The latest figures for unemployment show the position on April 16th, when 252,952 people were registered as out of work, compared with 274,861 a month earlier. The Ministry of Labour says that, in the week ended March 31st, about 18,000 operatives in the manufacturing industries were on short time, losing fourteen hours each on the average; on the other hand, 1,045,000 people were working, on an average, seven hours' overtime.

The Human Factor in Industry

On Friday last, May 18th, there was opened at the Safety, Health and Welfare Museum, Horseferry Road, London, S.W.1, an exhibition entitled "Manpower: The Human Factor in Industry." The exhibition has been arranged by the Ministry of Labour and has been designed to illustrate the more important factors in the efficient use of manpower to-day and also this country's achievements in the field of human relations in industry. The various sections of the exhibition—which will remain open until September 29th—deal with vocational guidance, employment and advisory services, training, resettlement of the disabled, industrial canteens, industrial health, industrial relations, and safety in the factory. There are also displays by the Shipping Federation, depicting its history over the last sixty years, and by the Amalgamated Engineering Union, showing the development of its organisation during the last 100 years.

The Mayor of Westminster, Councillor W. E. Rice, presided at the official opening of the exhibition last Friday, when an address was given by the Minister of Labour, Mr. Alfred Robens. Mr. Robens pointed out that the country's labour force could not be regarded as just so many heads or pairs of hands. Manpower, he said, was composed of a great number of individuals, each giving the contribution of a working life to the world, and, in the last analysis, it was still the human effort that gave vitality to productive processes. Without the human element, industry could produce nothing. To-day's problem, Mr. Robens continued, was that of increasing productivity with only a limited working population. In civil employment to-day there were nearly 22,250,000 men and women at work, but that working population was changing in pattern. Older folk were remaining in employment longer than they used to do, but, on the other hand, there was not the intake of young people that there used to be. Unfortunately, that tendency to a dwindling of the flow of new blood into industry was likely to go on for some years to come. The challenging fact, Mr. Robens emphasised, was that with a manpower supply which was almost inelastic, there had to be faced a manpower demand which was constantly expanding. The purpose of the exhibition, he added, was to display, as cogently as possible, what had been done, what was being done, and what could be done to make labour more productive.

British Overseas Trade

The final figures relating to British overseas trade in April were published by the Board of Trade at the beginning of this week, and show that the value of United Kingdom exports in the month was £230,200,000, a figure which offset the comparatively low average of £193,400,000 in the first three months of this year. The Board of Trade points out, however, that exports in the first quarter were affected by the Easter holiday, and also that the April figures may include some goods which, but for shipping difficulties, would have been sent overseas in the first quarter. The total value of United Kingdom exports in the first four months of this year was £810,900,000, an increase of 12 per cent on the monthly average for the whole of last year, and slightly above the average for the fourth quarter. The increase in April exports, compared with the first quarter of 1951, was shared by almost all commodities, those of metals and engineering products, valued at £105,100,000, being 17 per cent above the first quarter's average. In the vehicles group, a reduction in April for exports of ships and boats was more than offset by increases for all kinds of road vehicles. The number of new cars and chassis exported during the month was 34,067, compared with an average of 29,607 in the first quarter, and exports of commercial vehicles totalled 13,014, compared with an average of 11,342 in the first quarter. Exports of agricultural tractors, pedal cycles and motor cycles were all high in April. Export prices showed a further rise in April to 15 per cent above the 1950 average, but the Board of Trade says that most of the increase in the value of exports compared with the first quarter was due to the higher volume of goods shipped, the provisional volume index for April (1947=100) being 182, compared with 160 for the first quarter.

Imports during April were valued at £311,500,000, a figure 10 per cent above the first quarter average. Imports in the first four months of this year amounted in value to £1,159,600,000, which was 34 per cent above the 1950 average. It is stated, however, that a large part of the increase was caused by higher prices, the actual volume of imports being only about 7 per cent higher than the 1950 average. With re-exports during April estimated at £11,000,000, the excess of imports (valued c.i.f.) over total exports (valued f.o.b.) amounted to £304,700,000, against £125,600,000 in the same period last year.

Organisation of the Electricity Supply Industry

The British Institute of Management has published in booklet form a paper presented recently by Sir Henry Self, Deputy Chairman of the British Electricity Authority, on "Problems of Decentralisation in a Large-Scale Undertaking." The paper deals specifically with the organisation of the central authority and area boards of the electricity supply industry, and represents Sir Henry's personal views.

In the course of the paper, Sir Henry has discussed in some detail decentralisation problems in the area boards of the British Electricity Authority. He says that the regional autonomy of the area boards has been greatly helped by avoiding the imposition of rigid patterns of organisation and procedure. From this, he claims, there has naturally developed a spirit of friendly rivalry from which a valuable store of knowledge and practical experience of administrative and organisational problems is now being built up.

On the subject of delegation of authority, Sir Henry says that the intention is, throughout the B.E.A., to develop an organisation based on local operation and close contact with the consumer, combined with a flow of essential data back to headquarters to enable proper co-ordination and development of policy to be undertaken centrally. Delegation, Sir Henry adds, must go all the way, for only thus will it be possible to combat frustration and give the key personnel of the future a proper grounding with a balanced outlook and increasing responsibility as they work up through the organisation.

Notes and Memoranda

Air and Water

"Ocean Monarch."—The Furness Withy liner "Ocean Monarch," built at the Naval Yard of Vickers-Armstrongs, Ltd., has been awarded a gold medal, by the Academy of Designing in the United States, "for outstanding beauty and unusual design features of a cruise ship."

Air Traffic in March, 1951.—United Kingdom aerodromes handled 158,487 passengers in March, 1951. This was an increase of 22·7 per cent over the figure for March, 1950. Freight on and off-loaded increased by 41 per cent to a total of 2976·9 long tons. London Airport and Northolt together handled nearly 64 per cent of all passengers, and over 47 per cent of all air transport movements. Other busy airports for passenger traffic were Prestwick, with 8918 passengers, of whom 6128 were in transit; Glasgow (Renfrew), with 8900, all of whom were terminal; Belfast (Nutts Corner), with 8478, all terminal, and the Channel Islands, which together had 12,224.

International Shipping Federation.—The annual meeting of the International Shipping Federation was held in Paris on May 17th and 18th and fifteen countries were represented. The main purpose of the meetings, which were private, was to prepare a policy for the shipowners' group on the questions put before the Joint Maritime Commission of Shipowners and Seafarers, held this week in Geneva at the International Labour Organisation. The questions concerned the ratification of the Maritime Conventions adopted by the 1946 Seattle Conference. At the meeting Mr. Donald F. Anderson, the chairman of the British Shipping Federation, was appointed president, and Mr. W. N. H. van der Vorm (Holland), Commander Odd. I. Loennechen (Norway), and Mr. Maitland S. Pennington (U.S.A.) were elected vice-presidents. The Federation has been officially granted "consultative status" by the Economic and Social Council of the United Nations.

Miscellanea

Business Efficiency Exhibition.—The Business Efficiency Exhibition will open at Olympia, London, on June 6th, and will continue until June 16th. It is the thirty-seventh of such exhibitions organised by the Office Appliance Trades Association.

Tinplate Exports.—The President of the Board of Trade has said, in a Parliamentary reply, that United Kingdom exports of tinplate in the fourth quarter of 1950 to Europe were 6200 tons, and to South America, 8500 tons. In the first quarter of this year, the figures were 6700 tons and 10,300 tons respectively.

Schofield Scholarship Awards.—The Council of the Institution of Production Engineers announces that the 1951 Schofield Travel Scholarships have been awarded to Mr. F. W. Walton, Chairman of the Liverpool Graduate Section, and Mr. A. H. Needham, a graduate of the Lincoln Section. Mr. Walton, who is on the staff of British Insulated Callender's Cables, Ltd., will spend six months in the U.S.A., and Mr. Needham, who is a senior maintenance engineer of Robey and Co., Ltd., will visit Switzerland for six months.

Cambridge University Film Council.—The fourth report of the Cambridge University Educational Film Council, which has just been issued, comments on the increasing use of films in teaching engineering. Reference is made to an investigation carried out in the Department of Engineering on the effect of musical accompaniment to science films. Its results indicated that, in the conditions of an educational film session, an appropriate musical accompaniment to a silent film aids visual attention. Professor Sir W. L. Bragg, F.R.S., is President of the Society, and Mr. C. D. Pegge, M.A., of the University Engineering Laboratory, is the general secretary.

Government Vehicle Testing at Chobham.—The Ministry of Local Government and Planning states that since the decision was taken to authorise for a period of five years the use of land at Chobham, Surrey, for the fighting-vehicle design and proving establishment of the Ministry of Supply, there have been discussions with local authorities and private objectors about the exact sites of the hard running and endurance tracks for the testing of vehicles. The Government has now agreed that these should be placed further to the west, at Barrow Hills, near Longcross, instead of at Trumps Farm, as originally proposed. The purpose of this is to mitigate the nuisance to hospitals and to the neighbourhood generally.

Jaguar Factory Move Begun.—The preliminary stages have now begun for transferring the entire Jaguar plant to a new factory covering a million square feet on the north-eastern boundary of Coventry. The test department moved into its new quarters last week-end and will be followed almost immediately by the tool-room department. The complete transference of the machine shop will have been effected by August, and this will complete the first phase of the move. The second and final phase is planned to be completed by late autumn. Despite the magnitude of the undertaking, which involves the movement of over 10,000 tons of machinery and stores, it is not anticipated that there will be any interruption in normal production.

Institution of Chemical Engineers.—The annual general meeting of the Institution of Chemical Engineers was held at the Mayfair Hotel, London, on Friday last, May 18th. It was followed in the evening by a dinner attended by a large company of members and guests, and their ladies. Professor D. M. Newitt, F.R.S., President of the Institution, was in the chair. The toast of "The Institution" was proposed by Sir Frederick Handley Page, who spoke of the need to ensure in chemical engineering, and in other spheres of industry, that all should receive the best training possible in order that each could be of greatest value to this country, and thus enable it to achieve top place in a competitive world. After response by the President, the toast of "The Guests" was proposed by Dr. F. A. Freeth, Vice-President, and acknowledged by Sir Roderic Hill, Rector of the Imperial College of Science and Technology.

National Smoke Abatement Society.—The National Smoke Abatement Society has issued a new publication, entitled "Year Book, 1951," which contains information about the Society itself, its annual report and accounts, and a section of general information on air pollution and its prevention. There are notes and essential information on the laws relating to smoke and to alkali and kindred works, on the fuel efficiency activities of the Ministry of Fuel and Power, and on the work of the Fuel Research Organisation in the scientific investigation of pollution, the testing of appliances, and so on. There are also a directory of associations, a useful list of recent papers and reports, and a guide to publications. The Society's report for 1950 records an eventful year, which included coming-of-age celebrations, the inauguration of the annual Des Voeux Memorial Lecture, and the Fuel Efficiency Exhibition in Manchester under the Society's auspices. The book, which costs 1s., can be obtained from the Society at Chandos House, Buckingham Gate, Westminster, S.W.1.

The Late Mr. J. P. Reynolds.—We have learned with deep regret of the death, which occurred recently at his home at Esher, Surrey, of Mr. John Pickworth Reynolds, chairman and managing director of the Scottish Machine Tool Corporation, Ltd. Mr. Reynolds, who was sixty-five, began his long association with the machine tool trade in 1912, when he was appointed London representative of Loudon Brothers, Ltd. He continued in that appointment until 1923, when, with the late Mr. Thomas Wilson, he founded the firm of Reynolds and Wilson, which took up the representation in London of various North Country machine tool concerns. Later on, Mr. Reynolds resumed his connection with Loudon Brothers, Ltd., of which he became a director. On the formation of the Scottish Machine Tool Corporation, Ltd., in 1937, Mr. Reynolds was elected to the board, being appointed joint managing director, with the late Mr. Osbourne Bennie, in 1944. He became managing director a year later, and, on the death of Sir Harry Greer in 1947, he succeeded to the chairmanship of the corporation.

Launches and Trial Trips

Leasowe, passenger ferry; built by Philip and Son, Ltd., for the Wallasey Corporation; length between perpendiculars 145ft, breadth moulded 34ft, depth moulded 12ft 3in, passengers 1350; two Crossley diesel engines, each of 640 b.h.p. at 370 r.p.m. Launch May 18th.

Dalfonn, motor tanker; built by Harland and Wolff, Ltd., for Sigval Bergesen, Norway; length between perpendiculars 580ft, breadth moulded 78ft, depth moulded 42ft 6in, deadweight 24,000 tons; twenty-seven cargo oil tanks, two pump rooms; Harland-Burmeister and Wain two-cycle, single-acting opposed-piston oil engine, seven cylinders, 750mm diameter by 2000mm combined stroke, 110 r.p.m., two rotary blowers, two single-ended multitubular boilers. Trial May 15th.

Flying Buzzard, steam tug; built by Ferguson Brothers (Port-Glasgow), Ltd., for the Clyde Shipping Company, Ltd.; one set of steam reciprocating engines, by Ferguson Brothers, taking steam from one marine return-tube boiler burning oil fuel on Howden Wallsend system.

Derrymore, cargo ship; built by the Burntisland Shipbuilding Company, Ltd., for McCowen and Cross, Ltd.; length on waterline 435ft, breadth 60ft, depth moulded to shelter deck 39ft 6in, deadweight 10,570 tons, draught 26ft 7½in; Hawthorn-Doxford oil engine, four cylinders, 670mm diameter by 2320mm combined stroke, 4400 b.h.p., heavy oil fuel. Trial, May.

Magwa, motor tanker; built by the Furness Shipbuilding Company, Ltd., for the Afran Transport Corporation, of Liberia; length between perpendiculars 560ft, breadth moulded 80ft, depth moulded 42ft 3in, deadweight 24,400 tons on a draught of 32ft 3½in; twenty-seven cargo oil tanks, two pump rooms, four 500 tons per hour duplex steam pumps; Hawthorn-Doxford single-acting, two-stroke oil engine, three lever scavenge pumps, six cylinders, 670mm diameter by 2320mm combined stroke, 6600 b.h.p. at 115 r.p.m., one Scotch boiler and one Foster-Wheeler "D" water-tube boiler. Trial, May 11th.

Kokiri, motor coaster; built by Henry Robb, Ltd., for the Union Steamship Company of New Zealand, Ltd.; length between perpendiculars 290ft, breadth moulded 43ft, depth to upper deck 19ft 6in, deadweight 3030 tons, draught 17ft 3in; MacGregor steel hatch covers; two five-cylinder British Polar diesel engines, each of 1450 b.h.p. at 220 r.p.m., speed 11 knots. Launch, May 23rd.

Personal and Business

Mr. H. T. Chapman, M.I.Mech.E., F.R.Ae.S., has been appointed to the board of the Hawker Siddeley group.

The British Electricity Authority announces the appointment of Mr. O. S. Woods, A.M.I.Mech.E., A.M.I.E.E., as chief generation engineer (operation) of the East Midlands division.

The Saunders-Roe Organisation announces that Mr. M. J. Brennan, B.Sc., who has been technical assistant to Sir Arthur Gouge since 1947, has been appointed deputy chief designer.

The Scottish Machine Tool Corporation, Ltd., states that, following the death of Mr. J. P. Reynolds, Mr. Douglas Sharp has been appointed chairman, and Mr. H. M. M. Hyslop, managing director.

The Pulsometer Engineering Company, Ltd., Reading, has acquired the total share capital of Joseph Evans and Sons, Ltd., Wolverhampton, pump makers since 1810. Each organisation will continue to operate separately.

Mr. G. H. R. Towers, the managing director of John Readhead and Sons, Ltd., South Shields, has been appointed chairman of the Tyne Shipbuilders' Association in succession to Mr. J. Patton. Lieut.-Col. T. Eustace Smith was elected as vice-chairman.

Mr. V. H. F. Hopkins, M.I.Mech.E., has resigned his appointment with C.A.V., Ltd., to become chief engineer of Marshall, Sons and Co., Ltd., Gainsborough, and John Fowler and Co. (Leeds), Ltd. He will join the Marshall-Fowler organisation at the beginning of June.

Mr. D. McCall, M.I.N.A., managing director of Menzies and Co., Ltd., has been elected chairman of the Dry Dock Owners' and Repairers' Central Council. Mr. A. P. Traill, director and general manager of Manchester Dry Docks Company, Ltd., has been elected senior vice-chairman, and Mr. W. B. Johnstone, of Alexander Stephen and Sons, Ltd., junior vice-chairman.

F. J. Edwards, Ltd., 359–361, Euston Road, London, N.W.1, announces the appointment of Mr. L. Halliday as representative for the Lancashire, Cumberland and North Wales areas. Mr. Halliday will work mainly from the company's office at Lansdowne House, 41, Water Street, Birmingham, 3, but he will be available through his home address at 90, Yew Tree Road, Ormskirk, Lancs.

The Board of Trade announces that the Squires Gate Factory, Blackpool, has been allocated to the Hawker Aircraft Company, Ltd., of Kingston-on-Thames for the production of aircraft. The factory was built during the war and is approximately 1,250,000 square feet. It was used by Vickers-Armstrongs, Ltd., for the production of aircraft and later for the manufacture of aluminium houses. The factory has been empty since March, 1948.

British Patent Specifications

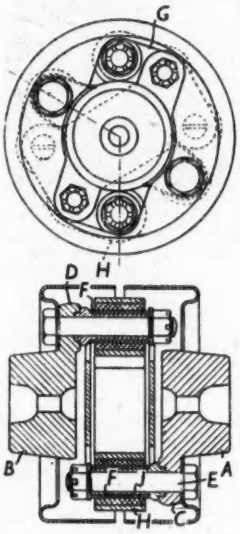
When an invention is communicated from abroad the name and address of the communicator are printed in italics. When an abridgment is not illustrated the specification is without drawings. The date first given is the date of application; the second date, at the end of the abridgment, is the date of publication of the complete specification.

Copies of specifications may be obtained at the Patent Office Sales Branch, 25, Southampton Buildings, Chancery Lane, W.C.2, 2s. each.

POWER TRANSMISSION

651,890. September 17, 1948.—Flexible Driving Coupling, Metalastik, Ltd., Evington Valley Road, Leicester, and Archie John Hirst, of the company's address.

The coupling shown in the drawings consists of two coupling flanges *A* and *B*, each having two opposed radial spider arms *C* and *D*, keyed on the driving and driven shafts. These flanges may be supplied with a small axial pilot bore so that they can be bored out to fit shafts of any diameter within the capacity of the coupling. The ends



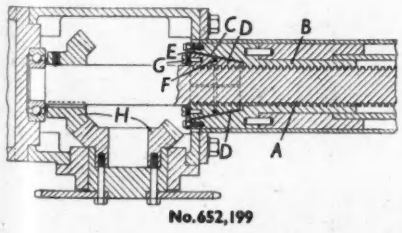
No. 651,890

of the arms *C* on the coupling flange *A* carry bolts *E*, which extend through the sleeves *F* of the bushes in the free ends of the links *G* and *H*. Each bolt carries a metal sleeve *J* and the sleeve *F* is clamped in an axial direction between a shoulder on the sleeve *J* and a washer and a nut screwed on to the free end of the bolt. The ends of the arms *D* on the coupling flange *B* carry similar bolts secured in the sleeves *F* in the free ends of the links. The complete coupling may be enclosed or shrouded by two co-operating flanged sheet metal pressings, which are located by the bolts, as shown.—*April* 11, 1951.

TOOLS AND WORKSHOP APPLIANCES

652,199. *December* 23, 1948.—Screw Jacks and Like Mechanisms, M. B. Wild and Co., Ltd., of 71, Argyle Street, Nechells, Birmingham, 7; and John Westley Boucher, of the company's address.

The invention comprises the combination with a nut and screw mechanism, of clamping means arranged in engagement with the screw and adapted to co-operate with a part formed on or secured to



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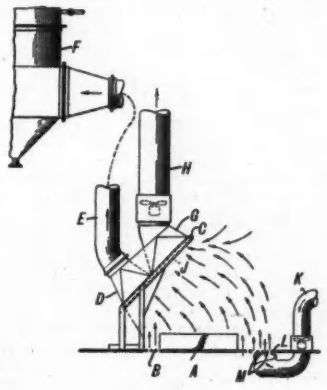
the nut, so that in the event of relative free axial movement of the nut and screw consequent upon stripping of the thread of the nut, the clamping means becomes wedged between the screw and the part, thereby rendering the mechanism inoperative. The accompanying drawing shows a screw jack mechanism in which the screw *A* is rotatable, but is axially fixed, and the nut *B* is axially movable but non-rotatable. At one end of the nut is a conical socket *C*, and in the socket is located a conical clamping piece *D* in the form of a nut, made from two or more parts, in engagement with the screw. This clamping piece has a limited freedom of axial movement in the socket and is held in position by an end cover *E*. It is held together with the screw by a spring ring *F* and is held against rotation by pegs *G*. In the event of stripping of the main nut due to wear while under load, the nut will first slip axially to a small extent relatively to the screw, in the direction which causes the clamping piece to be wedged tightly between the socket and the screw, thereby stalling the mechanism and rendering it inoperative. In the example given, the screw is rotatable by gear wheels *H*. The invention is applicable in essentially the same manner to a screw-jack mechanism in which the nut is rotatable but axially immovable, and the screw is axially movable but non-rotatable. The invention is also applicable to a variety of forms of screw jack or like mechanisms for different purposes.—*April* 18, 1951.

MISCELLANEOUS

651,660. May 25, 1948.—Apparatus and Method for Treating Rising Columns of Dust Laden Gas, Claude Bernard Schneible, of 9355, West Outer Drive, Detroit, Michigan, U.S.A.

This invention provides an apparatus for separating particles from a rising column of particle-laden gas containing dust, smoke and fumes, &c. In it are a number of vertically spaced suction intakes communicating with one side of the column and means discharging a stream of gas on the other side of the column to form a curtain and confine the column about intakes. The invention is illustrated in a single embodiment by the accompanying drawing, in which there is shown, in side elevation, a diagrammatic arrangement of a structure. In the drawing given *A* shows a grate having openings *B*, through which a rising column of gas, containing dust, smoke, fumes, &c., flows. The main frame supports a frame *C*, mounted in the



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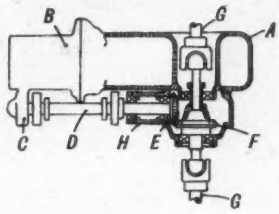
lower portion of which is an intake casing *D*, which opens laterally of and extends slightly over the rising column of gas. This intake communicates with a suction pipe *E* leading to a lateral inlet of a suction tower or column *F*, provided with the usual pipe, by which liquid, such as water, oil, solvents, or other treating material, is brought into contact with the rising gas. Supported in the frame *C* above the intake, is a second intake *G*, communicating with a pipe *H*, in which there is mounted a stack fan. The pipe leads to the atmosphere for the venting of material received. The frame is equipped with a group of parallel spaced louvres or ribs *J*. In operation the heavily-laden gas rises from the grate openings, and as the column rises, the intake creates suction, transversely of the column, and heavy particulate matter is drawn into the conduit *E* and discharged through the inlet into the tower *F*. After the removal of the heavier fraction, the lighter fraction containing the light smoke and fumes may be discharged upwardly through the pipe *H*. In order to increase the effectiveness of the fractionation and also to insure the recovery of all the volatile material, a fluid curtain device is used. It consists of a pipe *K* by which air is discharged under pressure through an elongated outlet *L* with louvres *M*, which may be substantially tear-drop shaped and breaks up the stream into separate streams of air.—*April* 4, 1951.

AUTOMOBILE ENGINEERING

652,422. February 12, 1948.—Improved Driving and Transmission Unit, Regie Nationale des Usines Renault, of 8, Avenue Emile Zola, Billancourt (Seine), France.

Referring to the drawing, it will be seen that the combined driving and transmission unit comprises an engine *A* coupled to a variable-speed gear *B*. This gear controls through a gear wheel *C* a shaft *D*, which transmits the drive to gearing constituted by bevel gears *E* and *F*, which are connected through a differential to cardan shafts *G* driving the wheels. The pair of bevel wheels, the differential and the cardan joints of the wheel-driving shafts extend through the lower part of the



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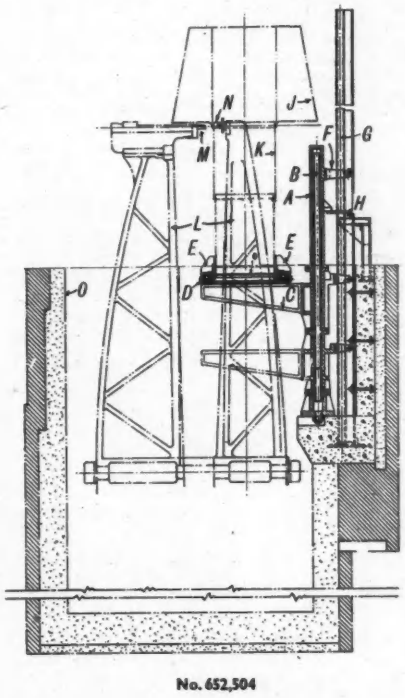
casing of the engine, and their axis passes between two adjacent big-end bearings through the sump of the engine. The casing *H* supporting the pair of bevel gears or worm gear and the differential may be secured by screws or bolts to the lower casing of the engine, or it may be made in one piece with the lower casing. The unit can be mounted either at the front or the rear of a vehicle.—*April* 25, 1951.

RAILWAY ENGINEERING

652,504. October 9, 1948.—Device for Riveting a Locomotive Boiler, Tata Locomotive and Engineering Company, Ltd., of Jamshedpur, Bihar, India; and William Harold Ames, of the company's address.

This invention relates to a device for holding the firebox and boiler barrel of a locomotive boiler to enable a gap riveter conveniently to effect riveting at all positions. Referring to the drawing, *A* is a vertical hydraulic cylinder with a ram *B*. The cylinder carries a fork-shaped bracket *C*, on which is mounted a fixed table *D* which constitutes the



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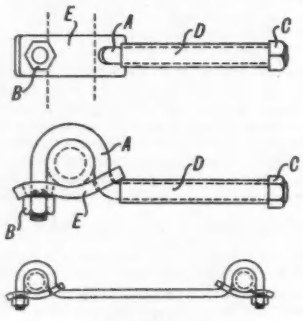
fixed roller race. Supported by the table is a turntable with moving roller race contacting with the rollers of the fixed roller race, which taper inwardly. On the top of the table are fixed boiler securing clamps *E*, the inside shape of the clamps being made to correspond with the shape of the lower end of the boiler. Integral with or secured to the cylinder *A* are guide pieces *F* with guideways and guide rollers engaging the flange of a vertical I or T-section guide bar *G*. *H* is a pair of supporting arms mounted on a platform to hold the cylinder by supporting its lug. A number of such lugs, one above the other, are provided. The boiler is shown supported by the turntable and held within clamps *E*. A boiler firebox is marked *J* and a boiler barrel *K*. A gap riveter *L* has a moving head *M* located externally and adjustably backing up snap *N* in the boiler as in standard practice. *O* is the foundation pit. The hydraulic cylinder is lowered or raised hydraulically to the position desired for the boiler to be riveted. It is maintained in any position along the vertical plane when supported

by the pair of arms and a number of lugs. The boiler while supported can be turned round according to requirements.—*April* 25, 1951.

STRUCTURAL ENGINEERING

652,455. July 27, 1948.—LADDERS FOR SCAFFOLDING, William Houliston (Reverend), Rockbeare Vicarage, near Exter, Devon.

The invention relates to the provision of steel open end rungs or treads to be attached at intervals alternately on opposite sides of a tubular steel scaffold pole. It also relates to steel double-ended rungs or treads to be attached to two scaffold poles. As illustrated, open-end steel rungs *A* are provided. The end of the rung, which partly encircles a tubular pole, is threaded to receive a fixing nut *B*,



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and the straight end of the rung forming the tread is threaded to receive a nut *C*. This nut holds in position the rubber treading *D*, provided to prevent foot slip, or alternatively the steel tread is roughened and the end nut prevents side foot slip. For fixing the rung or tread to a pole a closing or fixing clip *E* is provided. This clip has a hole which fits around the neck of the rung, and is partly made to encircle the pole and slotted to fit over the threaded end of the rung and turned outwards to prevent the rung being forced open by strain. An alternative method of constructing a ladder, when double-ended rungs are used, is illustrated, the steel being roughened to prevent foot slip.—*April* 25, 1951.

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of their insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME and PLACE at which the meeting is to be held should be clearly stated.

Chemical Council

Wed., May 30th.—Royal Institution, Albemarle Street, London, W.1, "Chemistry and the Conquest of Disease," J. W. Cook, 6 p.m.

Chemical Society

Thurs., June 7th.—Royal Institution, Albemarle Street, London, W.1, "A Chemotherapeutic Search in Retrospect," F. L. Rose, 7.30 p.m.

Engineers' Guild

To-day, May 25th.—N.W. BRANCH: Queen Hotel, Chester, "The Aims and Achievements of the Engineers' Guild, Ltd.," W. L. Henderson, 7.30 p.m.

Incorporated Plant Engineers

To-day, May 25th.—BIRMINGHAM BRANCH: Imperial Hotel, Temple Street, Birmingham, "Laundry Engineering," F. Q. Wheatcroft, 7.30 p.m.

Mon., May 28th.—W. AND E. YORKSHIRE BRANCH: The University, Leeds, "Recent Developments in Metallurgy," Dr. Irvine, 7.30 p.m.

Mon., June 4th.—LONDON BRANCH: Shell Mex House, Strand, London, W.C.2, Talk and Discussion on "Oil Refineries," 7 p.m., to be followed on June 5th by an all-day visit to Shellhaven.

Institute of Industrial Administration

Wed., May 30th.—LONDON CENTRE: Fyvie Hall, The Polytechnic, Regent Street, London, W.1, "Control Chart Techniques in Industry with special reference to Quality Control," B. P. Dudding, 6.30 p.m.

Institution of Electrical Engineers

Mon. to Wed., May 28th to 30th.—MEASUREMENTS SECTION: Savoy Place, Victoria Embankment, W.C.2, conference on "Electrical Instrument Design."

Wed., May 30th.—SCOTTISH CENTRE: Heriot-Watt College, Edinburgh, annual general meeting, 7 p.m.

Institution of Production Engineers

Wed., May 30th.—SHREWSBURY SUB-SECTION: Technical College, Shrewsbury, "Commercial Possibilities of the Lost Wax Process," A. Short, 7.30 p.m.

Junior Institution of Engineers

Thurs., June 7th.—MIDLAND SECTION: James Watt Memorial Institute, Great Charles Street, Birmingham, Festival of Britain—Special Meeting to commemorate this event, 7 p.m.

Royal Institution of Chartered Surveyors

Mon., May 28th.—12, Great George Street, Westminster, S.W.1, Annual General Meeting, 5 p.m.

Society of Engineers

To-day, May 25th.—17, Victoria Street, London, S.W.1, "Colloidal Mixes and Their Applications," C. L. Laing, 6.30 p.m.

Society of Instrument Technology

Tues., May 29th.—Manson House, Portland Place, London, W.1, Annual General Meeting, 7 p.m.

Stoke-on-Trent Association of Engineers

Sat., June 2nd.—Midlands Electricity Board, Back Glebe Street, Stoke, Annual General Meeting.

Women's Engineering Society

Sat., June 2nd.—LONDON BRANCH: Visit to Festival of Britain, 1951.

Contracts

MESSRS. OY STROMBERG AB have placed an order with Metropolitan-Vickers Electrical Company, Ltd., for fifteen sets of electromagnetic remote-control gear and thirty motor generator sets for incorporation in new tramcars being built for the Helsinki Tramway Company, Finland.

THE SOUTH-EASTERN GAS BOARD has placed with the Burntisland Shipbuilding Company, Ltd., an order to build an up-river motor collier of 2825 tons deadweight, which will have British Polar diesel propelling machinery of 1150 b.h.p., constructed by British Polar Engines, Ltd.

THE BURNTISLAND SHIPBUILDING COMPANY, Ltd., is to build for the Constantine Shipping Company, Ltd., a motor cargo vessel of 1610 tons deadweight, the propelling machinery consisting of a British Polar diesel engine of 800 b.h.p., which will be constructed by British Polar Engines, Ltd.

VICKERS-ARMSTRONGS, Ltd., announces that it has received an order for a number of swept-back-wing fighters to be known as the "Swift." This aircraft is to be fitted with a Rolls-Royce gas turbine, and is a similar aircraft to the machine known as the Supermarine "535," which first flew in 1950 and was powered by a Rolls-Royce "Nene" turbo-jet engine.

THE DE HAVILLAND AIRCRAFT COMPANY, Ltd., states that the Chargeurs Reunis S.A., of Paris, has placed an initial order for two series I "Comet" aircraft, which are fitted with de Havilland "Ghost" turbo-jet engines. The Series 2 "Comet," designed for longer stages and fitted with Rolls-Royce "Avon" turbo-jet engines, has been ordered by Panair do Brasil, and delivery is expected in 1954. A total of twenty-three "Comet" aircraft have now been ordered.

British Standards Institution

All British Standard Specifications can be obtained from the Sales Department of the Institution at 24, Victoria Street, London, S.W.1.

GUIDE TO THE METHOD OF SPECIFYING HELICAL COMPRESSION SPRINGS

No. 1726 : 1951. This standard applies to the following classes of helical compression springs :—

(*a*) Hot coiled springs, hardened and tempered after coiling.

(*b*) Cold coiled springs, not hardened and tempered after coiling.

(*c*) Cold coiled springs, hardened and tempered after coiling.

Most springs are made of steel but the recommendations given in this standard also apply, in general, to springs made from other materials. The main purpose of this standard is to clarify the specification of a spring by the designer, so that the manufacturer and the inspector will give him not only no less than he requires, but no more. This standard is concerned with the decision as to which dimensions require tolerances and as to what the extent of the tolerances should be. It is not concerned with drawing statement. However, it is recommended that the essential data should be presented in tabulated form, distinguishing between those which are required to define the finished article and those which are given merely for the information of manufacturer and/or inspector. In order to avoid placing on the manufacturer and inspector more work than is required to produce a spring that is adequate for the purpose intended, springs are graded in this British Standard in four categories. These categories range from the spring in which the performance is inferred from the dimensions, to the spring in which constant and accurate rate is the first consideration and has to be proved by inspection. The first category covers a considerable variety of springs, mainly light springs which are in common use. In the fourth category are dynamometer springs and balancing springs. The category of any particular spring will be apparent when the designer sets down those requirements of the spring which are important functionally.

The following appendices are included in this standard: Appendix A, dimensional and loading tolerances; Appendix B, methods of calculating rate, maximum shear stress, and natural frequency; Appendix C, end-coil formation and methods for calculating total number of coils, and Appendix D, glossary of terms and definitions relating to coil springs. Price 4s.

TOLERANCES FOR STEEL DROP FORGINGS AND UPSET FORGINGS

No. 1718 : 1951. This standard has been prepared at the request of the National Association of Drop Forgers and Stampers and is based on tables submitted by that Association. These agreed tables had been previously issued by the Association and are used by its members. It is hoped that their inclusion in one publication will satisfy a long felt need by simplifying the application of agreed limits to drawings, which, in the past, have often been deficient in this respect. Tolerances are given in tabular form and are designed to cover the general range of forgings of average form in all ordinary specifications. Drop forgings are dealt with under thickness, width and length, draft angles, fillet and male edge radii, and quantity. Horizontally upset forgings are dealt with under thickness, die wear and shrinkage, eccentricity and off-set length bar portion and quantity. Price 2s. 6d.

DETERMINATION OF TITANIUM IN PERMANENT MAGNET ALLOYS (PART 17) AND DETERMINATION OF CHROMIUM IN FERRO-CHROMIUM (PART 18)

No. 1121 : 1951. Each part of this British Standard includes details of reagents required, procedure and calculations. Two methods are specified for the determination of titanium. Using the gravimetric finish, titanium is precipitated with cupferron from a solution of the alloy containing the iron in the ferrous condition. After ignition and fusion, iron, copper and traces of nickel, cobalt, &c., are removed from an alkaline tartrate solution with hydrogen sulphide. Finally titanium is again precipitated with cupferron, ignited to oxide and weighed. Using the absorptiometric finish, hydrogen peroxide is added to an oxidised solution of the alloy in a mixture of sulphuric and phosphoric acids. The light absorption of the yellow coloured pertitanic acid thus produced is measured and related to a calibration curve prepared under the same conditions as the assay.

The method for determining chromium in ferro-chromium is by decomposition of the alloy by digestion with sulphuric acid, fuming with phosphoric acid, oxidation with silver nitrate/ammonium persulphate and titration with ferrous ammonium sulphate and standard dichromate using diphenylamine as an indicator. Price 2s.

Catalogues

REVO ELECTRIC COMPANY, Ltd., Tipton, Staffs.—Publication dealing with Revo electric fans.

NEWTON AND CO., Ltd., 72, Wigmore Street, London, W.1.—Booklet describing the profile projector.

HOPKINSONS, Ltd., Huddersfield.—Publication List 5003, giving details of remote water level indicator.

BRONX ENGINEERING COMPANY, Ltd., Lye, Road, Near Stourbridge.—Catalogue dealing with press brakes.

ASCOG, Ltd., Ascog House, 44, Theobalds Road, London, W.C.1.—Leaflet dealing with Lechlers sprayers.

J. H. FENNER AND CO., Ltd., Marfleet, Hull.—Catalogue describing the "Hainsworth" variable-speed unit.

BENJAMIN ELECTRIC, Ltd., Brantwood Works, Tariff Road, Tottenham, London, N.17.—Folder describing the "Photometer."

ENGLISH ELECTRIC COMPANY, Ltd., Queens House, Kingsway, London, W.C.2.—Publications entitled "'English Electric': The Power Behind the Jute Industry," and "Combination Fuse-Switchboards Meet Modern Factory Requirements."

RECORD ELECTRICAL COMPANY, Ltd., Broadheath, Altrincham, Cheshire.—Publications: A/h, "Instrument Switches"; A/m, "Induction Wattmeters"; A/n, "Dynamometer Wattmeters"; A/o, "Frequency Meters"; A/p, "Power Factor Meters."

STURTEVANT ENGINEERING COMPANY, Ltd., Southern House, Cannon Street, London, E.C.4.—Publication No. 4704, "Timber Seasoning"; publication No. 3603, "Exhaust Ventilation"; publication No. 9501, "Crushing, Grinding, Screening, Separating and Mixing Machinery."